

CURRICULUM VITAE

PAWAN K. KAHOL

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PROFESSIONAL PREPARATION

West Virginia University	Physics	Research Associate	1986-88
University of Stuttgart, Germany	Physics	Research Fellow	1984-86
University of Stuttgart, Germany	Physics	Alex v Humboldt Fellow	1983-84
University of Leeds, England	Chemistry	Senior Postdoctoral Fellow	1982
University of Leeds, England	Chemistry	Postdoctoral Fellow	1979-81
Panjab University, India	Physics	Postdoctoral Fellow	1978
Panjab University	Physics	Ph.D.	1979
Panjab University	Physics	M.S.(Honors)	1974
Panjab University	Physics	B.S.(Honors)	1973

APPOINTMENTS

Head, Department of Physics, Astro, & Mat Sci, Missouri State University	2005-present
Professor of Physics and Chemistry, Wichita State University	2004-2005
Associate Dean of Graduate School, Wichita State University	2003-2005
Chairperson, Physics Department, Wichita State University	2001-2003
Visiting Professor, Ohio State University, Columbus	Summer 2001
Professor of Physics, Wichita State University, Wichita	1998-2005
Visiting Professor, Ohio State University, Columbus	Fall 1997
Associate Professor of Physics, Wichita State University, Wichita	1992-98
Assistant Professor of Physics, Wichita State University, Wichita	1988-92

SELECTED AWARDS, HONORS, AND DISTINCTIONS

University and State Merit Scholarships in B.S. and M.S., 1971-1974
SERC Research Fellowships (U.K.), 1979-1982
Alexander von Humboldt Fellowship (Germany), 1983-1984
Deutsche Forschungsgemeinschaft Fellowship (Germany), 1984-1986
Winner, Academy for Effective Teaching Award for 2003 at Wichita State University
Faculty Inductee into the Golden Key International Honor Society

PROFESSIONAL ACTIVITIES

Member: Materials Research Society; American Physical Society; American Chemical Society;
Pi Mu Epsilon

PUBLICATIONS AND RESEARCH INTERESTS

Over 125 refereed publications, 2 review articles and over 135 international/national/regional presentations. Magnetism of *Nanoscale Particles*; Magnetic, EPR and Electrical behavior of *Conducting Polymers*; EPR and ENDOR of KDP-type *Ferroelectric crystals* and *Dipolar Glasses*; EPR and Magnetic Interactions in *Ferromagnetic/Antiferromagnetic Novel Materials*; *Spintronic Oxide Materials*; Thin Films of *Dilute Magnetic Semiconductors*; Organic-Inorganic Hybrid *Devices*; Nanocomposite Materials with High TCR (Temperature Coefficient of Resistance) for Infrared Detectors.

SIGNIFICANT ACTIVITIES AS THE DEPARTMENT HEAD OF PHYSICS, ASTRONOMY, AND MATERIALS SCIENCE (2005-present)

SHARED GOVERNANCE: DEPARTMENT COMMITTEES

I conceived and implemented several one-person department committees to engage every faculty member in department affairs. A list of existing committees that I have created in the Department is given below.

1. Program Review Committee: To produce a self-study report that includes strategic plans and curricular issues for all the programs in the department.
2. Department Personnel Committee: To evaluate tenure and promotion cases.
3. Merit Review Committee: To evaluate annual faculty performance and merit increases.
4. Undergraduate Labs Committee: To modify labs and lab manuals so that students learn and have great lab experiences.
5. Curriculum/ General Education Committee: To review curriculum once a year; review course description in undergraduate and graduate catalogs; and provide reports to and from the General Education committee.
6. Workload Committee: To create a workload policy.
7. Space Coordinator: To project and plan future department space needs; study current space issues; study renovations, beautification, and modernization; study electrical and computer hook ups, lighting, water lines and connections, and any plumbing issues.
8. Newsletter Coordinator: To prepare and distribute Newsletter in January (electronically and through mail); place Newsletter on our Website.
9. Department Brochures: To produce and update department brochures and Academic Program Guides.
10. Website Coordinator: To keep the Department website/webpage current with info and pictures; review the design and links once a semester; ask faculty for improvement ideas and current information.
11. Scholarships: To solicit, review, and recommend winners of the four Department scholarships to the Head (timeline, early spring); identify juniors/seniors or even sophomores for university and national scholarships, awards, and recognitions; find the best physics freshman, sophomore, junior, and senior based upon GPA (60%), research (20%) and involvement in physics activities (20%); compile guidelines for various awards; work with the college and university Development Offices on Awards.

12. Faculty Productivity coordinator: To compile annual department statistics on teaching (quality, quantity, awards, recognitions, graduate students graduated; etc.), research (publications, citations, presentations, paper and proposal refereeing, grants, awards, recognitions, etc.), and service (college and university committees; community boards and committees; department service; etc.).
13. Materials Science Brochure: To prepare a brochure on “Materials Science Research in the Department.”
14. Seminars: To arrange approximately 12 seminars per semester; post schedule (maybe partial) on the web; send electronic fliers to faculty, graduate students, CNAS dean and heads, all physics majors, and all those who are connected to the Department (like MVS, per-course faculty, in-town alumni)
15. Graduate Coordinator: To recruit graduate students; find strategies for recruitment; advertise inside and outside Missouri including international recruitment; respond to student inquiries promptly; send materials about our program and the university; present submitted materials by new possible admits for a decision in our monthly materials science group meeting; provide other updates; prepare a list of graduate students early into each semester and distribute it to faculty; work with the Head to make assistantship awards; communicate with the graduate college.
16. Recruitment and Retention Committee: To do recruitment and work on retention; mail Department materials to high schools and 2-year colleges; find ways and activities that will lead to increased enrollment; attend recruitment fairs; find ways to create a more welcoming environment to retain more students; have regular meetings with freshmen and sophomores and involve them in department and group projects; work with SPS; have frequent communication with physics majors especially freshmen and sophomores.
17. Assessment: Meet with graduating students and ask them to complete a survey; collect and compile information from the survey; compile MFAT results of graduating students; obtain employer feedback of alumni during past five years; compile a list of ACT scores of our physics majors; Compile info on presentations, exhibits, research papers, etc. for graduating students.
18. Annual Celebration Day Coordinator: Plan for the half-day retreat; recognize one faculty member for teaching and one for research; recognize one freshman, one sophomore, one junior, and one senior physics majors; recognize SPS and Astronomy Club executive members.
19. Graduate Students Workshop: To arrange a half-day Graduate Students workshop to talk about issues such as good teaching, ethical issues, research practices, legal issues.
20. SPS Advisor: To find ways to involve more students in SPS; meet with SPS every month; plan SPS activities including fundraising and picnics; Involve SPS in outreach community events including Science Olympiad, Open Day, and Science Fairs; check if SPS seniors would like to offer a help lab for physics students twice a week for one hour (coordinate if the answer is yes).

PH.D. PROGRAM IN MATERIALS SCIENCE

In July 2005, I was hired as the Head of the Department of Physics, Astronomy, and Materials Science at Missouri State University with the task of planning and implementing a PhD program in Materials Science. The implementation plan for a PhD in Materials Science has slowed down

because of administration changes and financial commitments. Nonetheless, I am continuing to develop a core of materials scientists who will be vital in establishing a great PhD program in Materials Science in the next few years.

I am working on many fronts to eventually develop a PhD program in Materials Science: (1) making collaborations with strong leaders who believe in creating a doctoral program of excellence; (2) developing a core of physics, chemistry, engineering, and biology faculty members, who, if already not doing interdisciplinary research, show commitment to creating an interdisciplinary doctoral program of excellence; (3) vigorous mentoring of interdisciplinary faculty members through individual discussions, weekly group meetings, and seminars; (4) new interdisciplinary hires in the critical areas of the doctoral program; (5) recruitment of excellent students into the program; (6) acquiring state-of-the-art equipment facilities for synthesis, characterization, device fabrication, and testing; (7) providing incentives to both students and faculty members for innovative ideas and research; (8) discussing a rigorous yet flexible curriculum; and (9) creating a pool of specialized knowledge.

I envision the Ph.D. program in Materials Science and Engineering to encompass the following objectives: (1) emphasize research into the fabrication and characterization of advanced electronic materials with a physical, chemical, biological, and engineering focus for future applications; (2) develop a curriculum that includes theories, experiments, processing technologies, applications, and business administration/entrepreneurship skills needed by students for success in industry; (3) develop a rigorous and robust research program where graduate students participate in externally funded research projects that have demonstrable scientific merits and societal impact; (4) develop a coherent and indigenous research program based upon local interest and national needs; (5) develop a place of excellence for materials science research in the state which will be a source of expertise for industry and other researchers at a multidimensional level; and (6) use faculty expertise to support a wide range of activities from bulk to micro to nano materials science, electronics, engineering, measurement techniques, instrumentation, biotechnology, and pharmaceuticals.

UNDERGRADUATE LABORATORIES

I believe that good laboratory experiences are essential for producing good scientists and bringing out the best in talented students who are interested in science and science careers. It is thus my conviction that we must provide the absolute “best” instruction in our undergraduate laboratories. It is in these laboratories that future Nobel Laureates are born.

Improving labs is a difficult and time-consuming process, but we have made many orders of magnitude improvements since I joined Missouri State University. We are in a constant mode to implement those physics experiments that bring to forefront the physics of the twentieth and the twenty first centuries. A lot still needs to be done to improve the physics undergraduate labs. In particular, we have done the following: (1) we are continuing to upgrade lab manuals and lab experiments for the introductory physics labs; (2) we are providing better instruction in the labs; (3) to make learning happen in the labs, we are creating a learning environment with proper equipment and inquiry-based labs; (4) we are providing half-day GTA workshops in fall and spring on how to be effective teachers in the labs; (5) we have provided enough stations (at least 12 for a lab of 24 students) for each laboratory experiment so that no more than two students are

working together; (6) we have introduced lab expectations at the appropriate course levels; (7) students are writing detailed lab reports and are doing detailed error analyses in their reports; (8) students are answering insightful pre-lab and post-lab questions; (9) we have introduced higher precision tools to make, for example, time, distance, speed, temperature, pressure, voltage, current, emf, and wavelength measurements; (10) old and unreliable equipment are being completely phased out; and (11) we have introduced PASCO interfaces and computers to do many lab experiments.

GRADUATE ASSISTANT WORKSHOPS

For the past three years, we have hosted in fall and spring half-day workshops for Graduate Assistants to impress upon them how to provide good teaching, how to respond to student questions, how to be courteous to students, what are ethical issues, and what are the university policies on academic dishonesty, sexual harassment, power play, discrimination, favoritism, and grades.

ADVISORY BOARD

After discussions with the Department faculty members, we established in 2006 an Advisory Board to assist in successfully accomplishing the mission of the Department. The Advisory Board is providing guidance and direction in: (1) improving public relations for the department; (2) making recommendations for development and fundraising; (3) assisting with ongoing long-range planning for the department; and (4) helping to ensure the department responds to and meets the needs of those who might employ our graduates. The Board meets in the week of Homecoming.

ENGINEERING PROGRAMS

I worked on bringing two Engineering Programs (Electrical and Civil) to Missouri State University. Missouri State University and [Missouri University of Science & Technology](#) are now offering these two engineering programs on the Missouri State University campus. We are continuing to offer a strong pre-engineering program to all students who wish to transfer to Missouri University of Science & Technology and major in other areas of engineering. Year 1 of the civil and engineering collaborative programs starts during the 2008-2009 academic year on the Missouri State University campus.

DUAL CREDIT PROGRAMS

We offer College Physics I for university credit to those high schools which have qualified physics teachers. I meet with the participating high school teachers twice a year with the following objectives: (1) to share successes and challenges on a regular basis; (2) to make certain that College Physics is taught at the same level as at Missouri State and grades are assigned with my approval; (3) to remind teachers that students are given tests including the final which meet Missouri State standards; (4) to monitor that coverage of the course material is reasonable and acceptable; (5) to discuss lab experiments which they have their students do in the labs; (6) to check the textbook, if not the one used here at Missouri State; (7) to be partners in this endeavor; and (8) to plan and coordinate on-site visits by the Head or his assignee.

RECRUITMENT AND RETENTION

This has become one of my top priority issues. Currently we have around 80 majors in the physics program and we need to increase this number to around 100. To accomplish this goal, I have appointed a team of faculty members, who passionately believe in going an extra mile to recruit and retain undergraduate and graduate students. This team will establish relationships with science teachers at local high and middle schools and visit each school in the Springfield area at least once a year; this will be a long term effort that will include inviting some of these teachers and students on campus and working with them. This team will also establish relationships with "local" universities and community colleges. Having a student-friendly website, producing high-quality brochures and CD's, and preparing FACT-sheets have also become our priority. We have also agreed to host the 2009 TEAMS competition (sponsored by JETS) with the objective of recruiting physics majors.

For higher retention of undergraduate students in the program, we have provided SPS (Society of Physics Students) significant roles, which include sponsoring department seminars, doing fund-raising, arranging picnics, arranging day tours to nearby places, and encouraging students to attend AAPT meetings. I visit with freshmen and sophomores every semester and even take them out to lunch; this I have found to be a very effective retention activity.

I do EXIT interviews with all graduating students and share anonymous student comments with all faculty members. My question for the Department is: What are we going to do and how are we going to take care of the student comments?

STUDENT HELP SESSIONS

Faculty members, who teach algebra-based and calculus-based introductory physics courses, agreed to set aside a minimum of two hours/week to help students with their difficulties. Faculty members meet with students (needing help) every day for two hours in an area specifically designed for student help. Since they were started last year, help sessions have become very successful. Up to six students can be seen working with a professor during these sessions. This activity is expected to lead to better retention.

STUDENT ORGANIZATIONS

I founded the Engineering Students Organization in 2006 and have since been its advisor. On July 23-25, 2006, three team members traveled to the Johnson Space Center in Houston for the annual MATE international underwater robotics competition. They competed against MIT, Carnegie Mellon, and several other well know engineering schools. At the end of the competition our team was given the "Rookie of the Year" award for the best first year team.

In 2007, our team competed in Newfoundland, Canada. The team created a robot that was able to (1) descend; (2) move forward the length of the tether; (3) move backward the length of the tether; (4) turn right and left; and (5) ascend. Our team did better than many teams from such schools as: University of Wisconsin-Milwaukee, University of California-San Diego, Dalhousie University, University of Waterloo, MIT, University of California-Davis, University of Alaska-Fairbanks, University of California-Santa Cruz, Arizona State University.

I am the faculty advisor of Indian Students Association. At Wichita State University also, I served for many years as the faculty advisor of the Indian Students Association.

SEMINARS

Since joining Missouri State University, the Department holds weekly seminars at a rate of 12 each semester. These seminars are an important component of the graduate as well as undergraduate programs. The talks on diverse topics add to intellectual growth and help us think out of the box. We have also endowed more than \$11,000 for the seminar series. Income thus generated helps us invite at least two renowned speakers to campus each year.

GRADUATE ISSUES

After meeting with appropriate persons from the Graduate College and International Payroll, I have streamlined the process that affects international graduate students.

NEWSLETTER

The Department published fall-2007 Newsletter after a break of 3 years; publication of the next Newsletter is certainly late, but should be out in a matter of weeks.

ACCELERATED MASTER'S PROGRAM

To strengthen our undergraduate and graduate programs, I initiated discussions with the dean of Drury University for Accelerated Master's Program in Materials Science. This effort has led to a much wider agreement with Drury University in a number of disciplines.

LIVING LEARNING COMMUNITIES

I am a faculty participant in a living learning community at Missouri State. Under this program, I (1) attend one social event/semester (for example, lunch or dinner with the floor); (2) attend one educational event/semester (for example, program held on the floor or elsewhere on campus); (3) present a program to members of the floor one time during the year; and (4) meet with the RA and the Hall Director at the beginning of each semester to discuss plans for the upcoming weeks. I feel a continuous intellectual growth in these freshman students as they interact with me and other faculty participants.

THANKSGIVING DINNER FOR INTERNATIONAL STUDENTS

International students are an integral part of any American university. There is simply so much that we are thankful for with respect to these students. They keep our research labs going, they present papers, they write papers, they teach our students in introductory labs, they add diversity to our way of life, teach us their culture and values, share their foods with us, and they help elevate Missouri State University's name to an international level.

Like I did at my earlier institution for many years, I started at Missouri State University the tradition of celebrating Thanksgiving Day with international students. The Department hosts a Thanksgiving dinner for all international students of the university—this is our way to make international students feel at home during Thanksgiving.

PRESIDENT'S COMMISSION ON DIVERSITY

This is my second year on this very significant committee/commission. In addition to making recommendations to the President on issues as and when they arise, we continue working on the following themes: (a) develop a Model for Inclusive Excellence at Missouri State University by researching AACU diversity initiatives and implementing campus-specific approaches; (b) identify most effective Diversity Training approaches for Administration, Faculty, and Staff; (c) identify institutions, organizations, individual and alumni contacts with diverse constituencies/populations; (d) develop Strategy/Presentation for Faculty Recruitment with effective marketing materials to attract diverse candidates; (e) develop Recruitment Relationships with appropriate organizations, individuals, civic leaders to identify prospective employees; (f) develop Effective Marketing Plan and materials for recruitment of diverse applicants and hires; (g) continue and enhance Urban Recruitment Alliance Program (URAP) model implementation in Kansas City, St. Louis, and Springfield; (h) implement Diversity Class Curricula; (i) Improve/Enhance Retention Functions within all appropriate areas of university; (j) improve Multicultural Leadership Scholarship Implementation & Deadlines; (k) coordinate outreach/recruitment with Admissions; and (l) assess and research Retention Strategies promoted by regional, statewide and national organizations addressing diverse student outreach, recruitment, retention, and career placement.

SIGNIFICANT ACTIVITIES AS THE ASSOCIATE DEAN OF GRADUATE SCHOOL (2003-2005)

STUDENTS COME FIRST

The mission of any Graduate School/College is to be an advocate for graduate education and provide quality service to graduate programs, faculty, and students with the goal of developing competent individuals who have achieved advanced abilities to address issues of significance for the quality of life. Students in graduate programs are expected to master special fields and develop appropriate methods of inquiry for future professional growth. A Graduate School/College thus endeavors toward these goals in partnership with students, faculty members, heads, deans, provosts, vice-presidents, and faculty and student councils. I want to see that our graduate students receive quality education and that they are motivated to take advantage of their fullest potential in making great contributions to their professional discipline. Within the scope of my position, I worked hard to provide such an environment.

I championed the cause of graduate education and the need to produce excellent graduate students. Teamwork is a necessary ingredient for the success of any group, organization, or institution. This is what I believe in and this is what I practice. My role in providing quality graduate education involved: dealt with issues such as enforcing GPA standards for incoming and outgoing graduate students, approved plan of study and the required courses; kept an oversight of department graduation time and rate; approved only genuine student exceptions; monitored CPT courses and OPT issues; disallowed unnecessary change of grades; followed rigorous guidelines for course validations; discouraged student employment violations; worked with the International Students office on SEVIS and other international student policies and issues; contributed to the development of EXIT survey for graduating graduate students;

participated in recruitment activities; contributed toward implementing electronic theses; worked on graduate student travels, liability issues, and waiver agreements; worked with the Assessment Committee for assessing various graduate programs; worked with the Department Coordinators to disseminate graduate information; reviewed data and helped with strategies to recruit graduate students; took care of degree audit exceptions; took care of student grievances; took care of student probations; took care of exceptions about courses from other universities; and worked with the co-op office to develop guidelines for those students who want to take co-op courses.

UNIVERSITY-WIDE RESEARCH SYMPOSIUM

I conceived, planned, and implemented a university-wide annual **Graduate Research And Scholarly Projects (GRASP)** symposium for a number of reasons that included: (i) spreading awareness on campus about the state-of-the-art research and scholarly projects being conducted in the six colleges and NIAR at Wichita State University; (ii) showcasing the world-class graduate research to the wider community; (iii) highlighting the participation of graduate students in research projects and recognizing their contributions to their field; (iv) acknowledging and recognizing research successes of the faculty advisors; (v) encouraging the development of presentational skills in research and scholarly activities; and (vi) providing an opportunity to experience academic diversity at the higher end of learning.

The university-wide symposium was a one-day event in the spring semester of 2005. All graduate students who are involved in research and/or scholarly projects were eligible to send an abstract for either an oral presentation or a non-oral presentation that included poster presentation, performance or exhibition. Three awards were made to oral presenters and another three to the non-oral presenters in the following amounts: 1st place - \$750; 2nd place - \$450; and 3rd place - \$300. Certificates of participation were offered to all participants and the winners were recognized/honored at the Graduate School Hooding Ceremony. Proceedings of the GRASP symposium were published after a suitable refereeing process. I understand that this symposium is being held each year.

GRADUATE EACHING ASSISTANT ORIENTATIONS

GTA orientations are a very important aspect of a Dean's position. A teaching assistant is both a student and a teacher and faces new expectations and responsibilities. No longer evaluated as just a student, a teaching assistant is held to a higher standard of conduct and must recognize the necessity of handling peer pressure, academic honesty, power, and authority. Students who feel intimidated and demeaned and who feel that a teaching assistant doesn't have his/her best interest at heart cannot be productive and creative. When students are prohibited from being productive, then teaching assistants have failed in their job. A teaching assistant's job is to enhance the learning experiences of students and to evaluate their performance. An orientation to accomplish these goals is by far one of the most important jobs of Graduate College. I have conducted the Teaching Assistant Orientations with passion and vigor.

GRADUATE TEACHING ASSISTANT PROCEDURE MANUAL

As the Associate Dean, I developed a Procedure Manual for Graduate Assistants. This manual described: (1) roles and responsibilities of Graduate Teaching Assistants (GTA), Graduate Research Assistants (GRA), and Graduate Staff Assistants (GSA); (2) graduate assistant

eligibility requirements, which included appointment eligibility, spoken English certification, visa type, and participation in Orientation Workshops; (3) graduate assistant conduct, ethics, and liabilities; (4) university policies against sexual harassment, academic dishonesty, grades and confidentiality, privacy of student information; (5) graduate assistant benefits, non-resident to resident tuition, in-state tuition waiver, university-sponsored health insurance, bookstore discounts, social security, and workers compensation; (6) graduate assistant performance expectations and evaluations, and grievance policies; (7) graduate assistant regulations and exceptions; and (8) important Graduate School forms and deadlines.

GRADUATE STUDENT ADVISORY BOARD

Set up a Graduate Student Advisory Board to obtain feedback on student concerns and to apprise them of latest graduate initiatives. The primary objectives of this student body were to: (1) promote and foster graduate education; (2) assist and contribute to all official university committees and governing bodies that affect graduate students; (3) provide the opportunity for communication, cooperation, and the exchange of ideas among graduate students, faculty, and the university administration; (4) serve as a central body to direct graduate student recommendations and/or grievances to the graduate school or the appropriate office; (5) improve the quality of graduate education; (6) serve as an organized representative body for the formulation of policies concerning graduate students; and (7) serve as the advisory board of graduate students to the graduate faculty and administration.

GRADUATE STUDENT AWARD COMMITTEE

I worked with this council to administer various Graduate School Awards. Each year, I appointed members to this committee, advertised various awards (which included outstanding master student, outstanding doctoral student, outstanding master thesis, outstanding master non-thesis, outstanding dissertation, summer research awards, McNair Scholars award, and many endowed scholarships), forwarded award materials to its membership, called meetings, forwarded names of winners to respective departments, printed award certificates, and recorded winners in the Graduate School databank.

ETHICAL AND PROFESSIONAL ISSUES FOR GRADUATE STUDENTS

It has occurred to me many times that while we do a good job with our GTAs on teaching, we kind-of ignore, of course not intentionally, the research duties and responsibilities that directly affect them. Come to think about it, only a small number of graduate students are GTAs and majority of them are involved in research. Honesty, integrity, ethics, safety, security, hazards, data-logging, and acknowledgements are among the many issues that research students must be made aware of. We do leave these matters for the faculty advisors to address, but beyond common sense they are not well informed about the above issues. I believe it is our duty to make sure that students have been given appropriate information before beginning to do research. For protecting the university, faculty members and the students themselves, we probably need to do at least one thing: put together a manual for graduate students that will guide their actions as they undertake research projects. I started putting together such a manual at Wichita State University, but could not finish it before relocating to Missouri State. Given financial resources, university-wide or college-wide workshops for graduate students should also be arranged each semester.

ACADEMIC PERFORMANCE REVIEW

Graduate students whose GPA dropped below 3.00 were placed on academic probation. At the end of each semester, the office manager provided me the block-outs for each graduate student whose GPA dropped below 3.00 and I provided the following possible outcomes: new probation, continued probation; no action; recommendation (from program); dismissal. These time-consuming actions are necessary to enforce quality graduate education.

STUDENT CAREER ADVISING

Throughout the semester, students scheduled appointments with me to discuss admission and career issues. I found this part of my duties extremely satisfying. My rewards are on the faces of happy and satisfied students.

PROGRAM REVIEW AND ASSESSMENT

In conjunction with academic programs, the Graduate Dean, and certain members of the Doctoral Sub-Committee, I was involved in performing assessment of programs, but my role was only secondary. The dean wrote assessment reports.

ANNUALIZATION OF MICHAEL TILFORD CONFERENCE ON DIVERSITY AND MULTICULTURALISM: STATEWIDE TILFORD CONFERENCE ON DIVERSITY AND MULTICULTURALISM

“The diversity of cultures is behind us, before us and all around us. The only demand we can make of it ...is that each make a contribution to the utmost generosity of other people.” Claude Levi-Strauss (1952)

Dr. Michael Tilford was a Wichita State University (WSU) administrator and served as the dean of the Graduate School from 1988 until his death in 1996. He was co-chair of the North Central Association accreditation team at WSU, chair of the Kansas Graduate Deans, member of the Council of Graduate Schools, and chair of the Midwestern Association for Graduate Schools. He also helped to conduct a study of the institutional commitment to minorities at WSU. The statewide Kansas Regents Conference on Diversity and Multiculturalism was started in 1994 and it was renamed the “Michael Tilford Conference on Diversity and Multiculturalism” in 1997.

The objective of my proposal to the Board of Regents in 2005 was to annually host the statewide “Michael Tilford Conference on Diversity and Multiculturalism” at Wichita State University.

TEACHING RESEARCH PHILOSOPHY

A practitioner of education who teaches with warmth, compassion, conviction, commitment, creativity, and to whom teaching is a creed is a teacher in the real sense of the word. Good teachers kindle a life-long fire of learning that transcends in one form or the other both inside and outside the classroom. I believe that every problem that we are confronted with today, from international competitiveness to our daily needs to our children’s future, ultimately rests on education and good teaching.

An effective teacher introduces difficult concepts in an easy way; has the abilities to explain and re-explain a concept in many different ways; never loses sight of the “big” picture; keeps students interested and inspired; stays enthusiastic; helps students as much inside the class as he/she does outside; learns from the way the students learn from him/her; and is always looking to introduce further improvements.

I consider it my responsibility: (i) to provide the best possible physics education in the classroom that will become an integral part of the students’ life, (ii) to “prepare” students for the tomorrow’s world of science and technology, and (iii) to give back many times more than what the community/country has given to me. I am never satisfied with meeting my requirements minimally. I want to be brilliant, I want my students to excel, and I want to take them out of the ordinary. My challenge is to relate what I am teaching to what very shortly will be expected of students in the society of doctors, scientists, and engineers.

Teaching and research are synergetic and are essential parts of an educator in the university setting. During my career as a physicist, I have published over 125 refereed research papers, made over 135 national/international presentations, wrote review articles, worked in the laboratories that are among the best in the world, worked on solution manuals on a calculus-based physics textbook, and have fostered collaborative relationships with many researchers all over the world.

UNDERGRADUATE BOOKS/SUPPLEMENTARY MATERIALS CO-AUTHORED

- (1) Pawan Kahol and Donald Foster—INSTRUCTOR SOLUTIONS MANUALS, VOL. 1 (ISBN: 0-8053-8986-5) “Physics for Scientists and Engineers: A strategic Approach (Randall D. Knight),” Addison Wesley, San Francisco, 2004.
- (2) Pawan Kahol and Donald Foster—INSTRUCTOR SOLUTIONS MANUALS, VOL. 2 (ISBN: 0-8053-8989-X) “Physics for Scientists and Engineers: A strategic Approach (Randall D. Knight),” Addison Wesley, San Francisco, 2004.
- (3) Pawan Kahol and Donald Foster—STUDENT SOLUTIONS MANUAL, VOL. 1, (ISBN: 0-8053-8708-0) “Physics for Scientists and Engineers: A strategic Approach (Randall D. Knight),” Addison Wesley, San Francisco, 2004.
- (4) Pawan Kahol and Donald Foster—STUDENT SOLUTIONS MANUAL, VOLS. 2 (ISBN: 0-8053-8998-9) “Physics for Scientists and Engineers: A strategic Approach (Randall D. Knight),” Addison Wesley, San Francisco, 2004.
- (5) Larry K. Smith, Marllin Simon, and Pawan Kahol—INSTRUCTOR SOLUTIONS MANUAL, VOL. 1 (ISBN: 0-8053-0495-9) “College Physics: A Strategic Approach (Knight, Jones, and Field),” Addison Wesley, San Francisco, 2007.
- (6) Larry K. Smith, Marllin Simon, and Pawan Kahol—INSTRUCTOR SOLUTIONS MANUAL, VOL. 2 (ISBN: 0-8053-0638-2) “College Physics: A Strategic Approach (Knight, Jones, and Field),” Addison Wesley, San Francisco, 2007.
- (7) Larry K. Smith, Marllin Simon, and Pawan Kahol—STUDENT SOLUTIONS MANUAL, VOL. 1 (ISBN: 0-8053-0632-3) “College Physics: A Strategic Approach (Knight, Jones, and Field),” Addison Wesley, San Francisco, 2007.

- (8) Larry K. Smith, Marllin Simon, and Pawan Kahol—STUDENT SOLUTIONS MANUAL, VOL. 2 (ISBN: 0-8053-0631-5) “College Physics: A Strategic Approach (Knight, Jones, and Field),” Addison Wesley, San Francisco, 2007.
- (9) Pawan Kahol, Donald Foster, Larry Smith, and Scott Nutter—INSTRUCTOR SOLUTIONS MANUALS, VOL. 1 (ISBN: 978-0-321-51621-3; 0-321-51621-4) “Physics for Scientists and Engineers: A strategic Approach (Randall D. Knight),” Addison Wesley, San Francisco, 2008.
- (10) Pawan Kahol, Donald Foster, Larry Smith, and Scott Nutter—INSTRUCTOR SOLUTIONS MANUALS, VOL. 2 (ISBN: 978-0-321-51657-2; 0-321-51657-5) “Physics for Scientists and Engineers: A strategic Approach (Randall D. Knight),” Addison Wesley, San Francisco, 2008.
- (11) Pawan Kahol, Donald Foster, Larry Smith, and Scott Nutter—STUDENT SOLUTIONS MANUAL, VOL. 1, (ISBN: 978-0-321-51354-0; 0-321-51354-1) “Physics for Scientists and Engineers: A strategic Approach (Randall D. Knight),” Addison Wesley, San Francisco, 2008.
- (12) Pawan Kahol, Donald Foster, Larry Smith, and Scott Nutter—STUDENT SOLUTIONS MANUAL, VOLS. 2 (ISBN: 978-0-321-51356-4; 0-321-51356-8) “Physics for Scientists and Engineers: A strategic Approach (Randall D. Knight),” Addison Wesley, San Francisco, 2008.

SUCCESSFUL GRANTS

1990-1991 Research Corporation, \$18,200.
 1991-1993 American Chemical Society, \$20,000.
 1993-1995 Research Corporation, \$14,000.
 1995-1997 Research Corporation, \$14,000.
 1995 NSF (EPSCoR) + LAS (1995), \$150,000.
 1992-1993 NSF (EPSCoR), \$40,000 from a total award of approx. \$400,000.
 1993-1994 NSF (EPSCoR), \$40,000 from a total award of approx. \$400,000.
 1994-1995 NSF (EPSCoR), \$40,000 from a total award of approx. \$400,000.
 1995-1996 NSF (EPSCoR), \$30,000 from a total award of approx. \$400,000.
 1996-1997 NSF (EPSCoR), \$30,000 from a total award of approx. \$400,000.
 2001-2005 American Chemical Society, \$30,000.
 2006 Missouri State University, \$250,000, x-ray diffractometer
 2007 NSF (co-PI), \$350,000, SQUID Magnetometer
 2008 NSF (co-PI), \$450,000, Scanning Electron Microscope
 2009 NSF (PI), \$460,000, EPR Spectrometry (to be submitted)
 My collaborators and I have received a sum of approximately \$4,000,000 from outside agencies to support research.

RESEARCH WITH SCHOOL TEACHERS AND COLLEGE PROFESSORS

Mark William (College Professor) — KDP-type ferroelectric crystals, 1991-1994;
 Marcia Costello (High School Teacher) — Mixed crystals, 1993;

Bill Cooper (High School Teacher) — Dielectric constant measurements, 1995, 1996;
Linda Snyder (High School Teacher) — Stretched films of polymers, 1996;
Kent Noffsinger (College Professor) — Iodine doped linear chain copper system, 1999.

RESEARCH WITH POST-DOCTORAL FELLOWS

Dr. N.J. Pinto — 1991-1993;
Dr. A.J. Dyakonov — 1993-1996;
Dr. A. Raghunathan — 1997-1999;
Dr. R. Gupta — 2006 - present.

RESEARCH WITH HIGH SCHOOL STUDENTS

S. Shah – Spring 1999, “a new charge transfer system.” published a paper, attended an international conference in Austria.

GRADUATE THESES SUPERVISED

- (1) "Magnetic susceptibilities of Al, Pt and Ni(II) monothiocarbamate using a force magnetometer," Yaoxiong Wu, May 1990.
- (2) "Atomic dynamics in ferroelectric CsH_2AsO_4 via model simulations of EPR line shapes," Darrell Scoular, December, 1990.
- (3) "Dependence of the magnetic state of polyaniline on absorbed water," Hong Guan, April, 1991.
- (4) "Computer driven system for ac susceptibility measurements for characterizing high- T_c superconductors," Ikoma George, July, 1993.
- (5) "Magnetic susceptibility investigations of hexameric nickel ring," Yuxin Tian, July, 1993.
- (6) "Electron localization effects in polyaniline copolymers," Vandana Pendse, July, 1994.
- (7) "Electron-Paramagnetic-Resonance line shape studies of RbH_2AsO_4 , RbD_2AsO_4 , and $\text{Rb}_{1-x}(\text{NH}_4)_x\text{H}_2\text{PO}_4$," Xianyao Lao, May, 1994.
- (8) "Electron localization in polyaniline derivatives," Wayne Spencer, July, 1994.
- (9) "Calculation and study of the fourth moment in zero field NMR," Vassilis Baboulis, May, 1996.
- (10) "Magnetization studies of iron dispersed in pitch," Hassan Khashfa, May, 1996.
- (11) "Moisture effects on conduction in polyaniline," Priti Shah, July, 1996.
- (12) "Vibrating Sample Magnetometer: Installation, Calibration and Measurements," Saman Dharmatilleke, July, 1997.
- (13) "Flux quantization and practical applications of YBCO SQUID," Tracy Tuttle, July, 1997.
- (14) "Transport and Magnetic Studies of Polyaniline," N. V. Amarsinghe, May 1998.
- (15) "Magnetic Susceptibility Analysis of Conducting Polymers," S. Ayesh, May 2005.

- (16) “Growth and Characterization of Cobalt Doped Indium Oxide Thin Films,” N. Mamidi, December 2007.
- (17) “Metal-Insulator Nano-Composites,” Satya Ganti, December 2008.
- (18) “High Dielectric Materials,” Yogini Dhopade, current student

COURSES TAUGHT

Physics I (algebra + trigonometry based)	Physics II (algebra + trigonometry based)
Physics I (calculus based)	Physics II (calculus based)
Topics in Modern Physics	Modern Physics
Solid State Physics	Solid State Physics (Graduate)
Modern Optics	Chemical Physics
Magnetic Resonance Phenomena (Graduate)	Electricity and Magnetism
Elementary Mechanics	Classical Mechanics (Graduate)
Solid State Physics	Laboratories (Mechanics and E&M)

DEPARTMENT, COLLEGE, AND UNIVERSITY SERVICE

Head of Physics, Astronomy, and Materials Science at Missouri State Univ, 2005-present
 Member President’s Commission on Diversity, 2007-present
 Physics Event Coordinator, Science Olympiad, 1989-2005
 Senator Roberts Task Force Member on Science, Technology, and the Future, 1998-2005
 Advisor to Indian Students Association, 1991-1994; 1999-2005
 Steering Committee Member, Department of Defense Statewide EPSCoR Program, 2000-2005
 Associate Dean of Graduate School, 2003-2005
 Department Chair, 2001-2003
 University Curriculum Committee, 2001-present
 Faculty Senate Member, 2002-present
 Graduate Coordinator, Physics Department, 1990-1995
 University CAPC Committee, 1992-1995
 Scholarship and Financial Aid Committee, 1994-1997; 1998-2001
 Academic Affairs Committee, 1995- 1998
 College Governance Task Force, 1996-1997
 College Retrenchment Committee, 1997-98
 Undergraduate Coordinator, Physics Department, 1996-2001
 Advisor to SPS, 1996-2001
 College Council, 1998-2000
 McGregor Scholarship Selection Committee Member, 1999-2000
 University Exceptions Committee, 1999-2003
 Honors Exploratory Task Force Member, 2000
 Tenure and Promotion Committee, 2001-2003
 Dean Search Committee, 2001-2002
 Faculty Advisory Council, 2003-2005

JOURNAL REVIEWER FOR

- (1) Physical Review B
- (2) Physical Review Letters
- (3) J. Phys.: Condensed Matter
- (4) Ferroelectrics
- (5) Synthetic Metals
- (6) J. Phys. D: Applied Physics
- (7) J. Applied Polymer Science
- (8) Solid State Communications
- (9) Physica D
- (10) Polymer
- (11) Macromolecules
- (12) Thin Solid Films
- (13) Materials Letters
- (14) J. Physical Chemistry

SOME SIGNIFICANT RESEARCH ACCOMPLISHMENTS

- | | |
|--------------|---|
| 1976 | Proposed a theory of collective motions in liquids. |
| 1978 | Proposed a theory of backflow effect in classical plasma. |
| 1979-80 | Developed a theory of deuterium NMR spin echoes in solids. |
| 1980-83 | Developed a theory of proton NMR spin echoes in solids. |
| 1980-83 | Developed a methodology for structural determination using NMR. |
| 1983 | Developed a methodology to determine accurate chemical shifts in solids. |
| 1985 | Developed a confined soliton model in conducting polymers. |
| 1986 | Developed an exchange-coupled pairs model for magnetic susceptibility. |
| 1986 | Developed analytical expressions for the ESR and ENDOR lineshapes in solids. |
| 1990 | Obtained analytical expressions for NMR moments in solids. |
| 1989-91 | Developed an ENDOR methodology near the phase transition in KDP-type systems. |
| 1994 | Analyzed magnetic susceptibility of conducting polymers in terms of triplet bipolarons. |
| 1991-98 | Developed methodologies for understanding moisture effects in conducting polymers. |
| 2002 | Observed experimentally and developed a model of Pauli magnetism in insulating plastics. |
| 1993-2005 | Provided evidence for inhomogeneous structural disorder in conducting polymers. |
| 2005-present | Developed new materials which are highly conducting and transparent with mobilities as high as $350 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$. |
| 2005-present | Working on materials with very high Temperature Coefficient of Resistance |

RESEARCH PROJECTS

Atomic dynamics in classical liquids: As a graduate student, I developed theoretical models to investigate dynamic structure factors $S(q, \omega)$ in simple classical liquids including classical plasma and molten salts. The model calculations were usually performed using static structure factors $S(q)$ (or pair correlation functions) and frequency moments.

NMR solid echoes in molecular systems: During my first post-doctoral assignment (1979- 1982) in England at the University of Leeds, I developed theories of deuterium and proton NMR spin echo responses in molecular solids. The solids on which I also made spin echo response measurements were: salt hydrates, thermotropic and lyotropic liquid crystals, phospholipids, metal difluorides, polyethylene, electrolyte glasses, and n-alkanes.

Local dynamics in ferroelectric and molecular crystals: As a postdoctoral fellow at West Virginia University (1986-1988), I undertook a complete ESR and ENDOR study of KDP-type ferroelectric crystals. Direct evidence for the presence of correlated relative motions of the type $\text{Cs-H}_4\text{AsO}_4$ and $\text{H}_4\text{-AsO}_4$ was provided in CsH_2AsO_4 . A methodology was developed to perform ENDOR experiments near the ferroelectric- paraelectric phase transition temperatures of the KDP-type of ferroelectrics. Complementarity of ENDOR and ESEEM (electron spin echo envelope modulation) techniques was shown, indicating the utility of ENDOR for investigating the mechanism of ferroelectricity of these compounds. In my laboratory at WSU, quantitative ESR studies of the arsenate center in rubidium dihydrogen arsenate and deuterated rubidium dihydrogen arsenate were undertaken. It was shown that fluctuations in the nonsymmetric distribution of the electron density are responsible for the observed ESR behavior in all KDP-type systems. We also developed a methodology for investigating dynamics of various spin probes in mixed/glassy systems of the KDP type.

High-temperature superconductivity: We were amongst the first three groups to report the existence of a non-resonant ESR spectrum in Y-Ba-Cu-O which extended from nearly zero field to very high fields. We were the first to conclude that the complex patterns in the ESR spectrum were due to the presence of numerous Josephson loops of sizes in the range of 0.6- 0.8 μ .

Conducting Polymers: Much of my research has been stimulated by the observation that the presence of moisture leads to enhancement of conductivity of polyaniline in the protonated emeraldine base form. Our initial investigations in this area focused on the effects that moisture removal has on the magnetic state of polyaniline as determined through thermal annealing of samples followed by measurements of magnetic susceptibility. It was shown that thermal annealing leads to the conversion of Pauli to Curie spins and it was proposed that removal of water leads to increased localization of spins due to increased pinning of the charge and spin on the polymer backbone in the vicinity of the chloride anions. Subsequent work in which d.c. conductivity was paired with magnetic susceptibility showed that the insulator-to-metal transition in HCl-doped emeraldine base is driven by disorder. We asserted that in the range y_c , the interchain structural disorder arising from the overwhelming amorphous content and small size of the semicrystalline regions induces enough intrachain electronic disorder that the electron wavefunctions are localized on individual chains. Thermal aging reduces the interchain disorder

of the loosely packed structure by introducing more regularity between the chains, leading thereby to increased localization length. Above y_c the crystalline regions are tightly packed and we contended that water molecules hydrating the chloride ions contribute to the overall structural order. Liberation of water by thermal aging introduces more interchain electronic disorder through changes in the potential barriers at sites close to the chloride anions. This is reflected in a decrease in localization length. Quantitative interpretation was achieved using a model that incorporated quasi-one-dimensional hopping between next nearest neighbor chains and values of α^{-1} as a function of protonation level (y) were obtained. These results clearly showed localization-to-delocalization behavior of the electron spins through the transition region. Similar work was carried out to determine the dependence of the magnetic state of poly(*m*-toluidine) on the presence of absorbed water. It was found that the binding of water in toluidine is weaker than in polyaniline. Samples of polyaniline doped with camphorsulfonic acid and lying in the metallic and critical regimes of the metal-insulator transition were also studied under different thermal conditions. It was found that the temperature above which the resistivity indicates metallic characteristics depends sensitively on the presence of moisture.

Studies of charge transport and electron delocalization through magnetic, conductivity, and ESR measurements were also carried out on the following polyaniline derivatives: poly(*o*-toluidine), poly(*o*-ethylaniline), and poly(*o*-propylaniline). It was shown that the presence of substituents on the aromatic rings of the polymer backbone lead to decreased conductivity, decreased Pauli susceptibility, and an increased number of Curie spins. Concomitant with these conclusions was the result that increasing the substituent size leads to increasingly small localization length, a conclusion that also was consistent with the observation that the ESR lineshapes trended from Lorentzian for polyaniline to Gaussian for poly(*o*-propylaniline). This localization is believed to arise from decreased interchain diffusion rates and reduced interchain coherence resulting from the alkyl groups randomly situated on the phenyl rings. Dielectric and ac conductivity measurements were also made on the above systems to investigate deeper the questions related to localization.

In order to better understand the issue of disorder in ring-substituted polyaniline derivatives, we investigated the magnetic and transport behavior of the co-polymer poly(aniline)_x(*p*-fluoroaniline)_{1-x} where x ranges over five different values. It was found that the electron localization length in the co-polymer is nearly equal to the conjugation length and that it decreases on decreasing x . It was suggested that the primary cause of localization in the derivatives is enhanced interchain disorder.

Although the magnetic susceptibility of polyaniline has frequently been analyzed in terms of a temperature independent Pauli component and a temperature dependent Curie component, the measured susceptibility is not a simple sum of Pauli and Curie components. Furthermore, as indicated in our previous work, the Pauli susceptibility of *o*-substituted derivatives yields rather large values of χ_p [approximately 65×10^{-6} emu/mol two-ring unit]. Yet the electron states in these derivatives are nonmetallic. Thus we felt the observed values for the Pauli susceptibility seemed to require a different interpretation, which also is suggested as necessary by some spin dynamics work. Accordingly alternative interpretation of the magnetic susceptibility of polyaniline and its derivatives in terms of singlet and thermally excited triplet bipolarons was

attempted. It was shown that the temperature dependence of the density of triplet bipolarons is qualitatively similar to that deduced from the spin-dynamics studies on polyaniline.

Since the conductivity in polyaniline is strongly limited due to disorder, reducing the amount of disorder results in enhanced conductivity. To increase conductivity it has been known for some time that aligning polymer chains through stretching of films increases conductivity along the stretch direction. We showed that the conductivity in polyaniline blends can also be enhanced to some extent if the conductivity of chain segments of the polymer within the disordered regions of the bulk could themselves be increased subsequent to processing.

In addition to studies of polyaniline systems through the application of magnetic and conductivity studies as described above, we used ESR extensively as a probe. These studies have focused on the interaction of molecular oxygen with polyaniline, it being well established that while molecular oxygen does not have much effect on d.c. conductivity, it causes significant changes in ESR linewidth and line shapes owing to magnetic interactions with paramagnetic polaronic centers in doped polyaniline. We used the oxygen-polaron interaction as a paramagnetic probe, in addition to studying the polarons themselves, which are natural, intrinsic paramagnetic centers. Work to this point was focused on the way in which water absorption can be monitored through measurements of the interactions of molecular oxygen with the polarons in the presence and absence of moisture. These studies led us to propose a “variable-size metallic island” model, in which protonated and highly ordered regions (metallic islands) are separated from amorphous regions by a less ordered region whose width depends on the amount of moisture present in the sample. Water reduces the width of the boundary region by introducing order, thereby transforming partly localized polarons into either delocalized polarons or bipolarons. We further proposed that conductivity enhancement arises from the increase in size of the metallic islands as the amount of moisture in a sample increases. We also showed that water molecules are absorbed at two different sites and that the observed ESR behavior of polyaniline and its derivatives can be interpreted as arising from the delocalized versus localized nature of spins.

Polyanilines having alkoxy groups located on the phenyl rings have been found to give rise to higher conductivities than those having alkyl substituents. This observation led us to study a series of alkoxy derivatives, and a blend of polyaniline and poly(*o*-methoxyaniline). Also the effect of oxidant/monomer ratio and rate of addition of oxidant was investigated. Again a quasi-one-dimensional variable range hopping model was used to analyze the results. All of the materials studied exhibited a Pauli-like susceptibility that indicated the existence of ordered regions. The electron localization length was found to be much larger in the poly(*o*-alkoxyanilines) than in the corresponding poly(alkylanilines), consistent with the higher conductivities in the poly(*o*-alkoxyanilines). We proposed that the effect of the alkoxy groups arises from the electron-donating ability of these substituents relative to the alkyl groups. It also was determined that the samples prepared with large amounts of oxidant are more disordered than the materials prepared in the usual fashion with an oxidant/ monomer ratio of about 1.35.

Nanoscale Particles and Polymetalorganosiloxanes: Graphitic materials in the form of fibers, filaments, and tapes have been of great interest over the past decade or so owing to their unique

and useful properties. In recent years there has been increasing interest in nanoscale materials as well. In our laboratories we have been interested in combining these two materials, and we have developed methods for depositing various iron-containing nanoparticles in petroleum pitch, which then can be thermally decomposed to provide various graphitic phases containing iron-containing nanoparticles. The low temperature materials contain nanoscale superparamagnetic iron particles dispersed in a modified pitch matrix. Graphitic structures have been shown to form in the temperature range 350-1650 °C. At 350°C the superparamagnetic iron particles begin to show bulk ferromagnetic behavior and at 650°C the system becomes highly anisotropic. At the same time iron carbide begins to appear and at 1000°C the concentration of iron carbide is about the same as that of iron itself. Simultaneously the pitch matrix undergoes changes with the formation ultimately of a layered structure. Finally, some work has been done on the magnetic characterization of polymetallic organosiloxanes containing Fe³⁺ and Co²⁺.

Dilute Magnetic Semiconductors: Over the past few years, we have been investigating the effects of nonmagnetic doping and substrate variation on the structural and electro-magnetic properties of oxide-based thin films of dilute magnetic semiconductors (DMS). We have successfully grown (Zn,Mn)O epitaxial thin films—doped with nonmagnetic Al and Cu—on various substrates such as Sapphire, Silicon, Glass and Quartz using the PLD (Pulse Laser Deposition) technique under suitable epitaxial growth conditions. All the films were grown using appropriate ceramic targets made by standard solid state reactions. Because the structural and physical properties of the films are sensitive to the deposition conditions, we have been able to obtain optimum deposition conditions: temperature of ~ 600C, a partial oxygen pressure in the range 1×10^{-5} - 5×10^{-5} Torr, and laser energy in the range 2-3 J-cm⁻². Structural and electro-magnetic properties of nonmagnetic (Al and Cu) doping of Zn_{0.85}Mn_{0.15}O (ZnMnO) were studied using Raman Spectroscopy, XRD, SEM, and Magneto-Transport. Magnetic and electrical properties depend on many factors such as doping, film to substrate strain, oxygen content, and growth temperature of the substrate. The electronic properties also depend on whether the type of doping is by magnetic or nonmagnetic atoms as, for example, the behavior of electrical resistivity is different for Mn- and Al-doping. In general the resistivity of the ZnO, Mn-doped ZnO, and Al-doped ZnO films decreases gradually with an increase in temperature, which indicates semiconducting behavior of these materials.

We have also studied the dependence of growth temperature on Mn-doped ZnO. Growth temperature changes the strain in and oxygen content of the films which play important roles in determining the structural and electronic properties of the films. One of the most interesting results that we believed to have found is that one can obtain both *n*- and *p*-type semiconductors Mn-doped ZnO DMS under different growth temperatures. The field dependence of R of ZnMnO grown at room temperature and at 400 °C proves this behavior. Further experiments are in progress to investigate the *n* versus *p* nature of these oxide-based semiconductors.

High TCR Materials: Devices such as temperature sensors, temperature switches, infrared detectors, night vision systems, thermal imaging systems, and bolometers are fabricated using materials which are sensitive to changes in temperature. The change in temperature typically manifests as change in electrical resistance and a quantity $\frac{1}{R} \frac{dR}{dT}$, commonly called the

temperature coefficient of resistance (TCR), is used to characterize a material's usefulness for temperature-resistance applications. Because TCR is the fractional change in resistance of a material due to a small change in temperature, high TCR materials continue to be sought after for developing highly sensitive sensors and devices. We have developed materials which have at least two orders of magnitude larger TCR compared with the existing materials.

LIST OF REFEREED PUBLICATIONS

- (1) P.K. Kahol, R. Bansal and K.N. Pathak, "Viscosities of Liquid Rubidium," *J. Phys. C: Solid State Physics* 8, 1823 (1975).
- (2) P.K. Kahol and R. Bansal, "An Estimate of the Wave-Number Dependence of the Relaxation Time for the Longitudinal Mode in Simple Liquids," *Progress of Theoretical Physics* 53, 885 (1975).
- (3) P.K. Kahol, R. Bansal and K.N. Pathak, "Collective Excitations in Liquid Rubidium," *Physical Review A* 14, 408 (1976).
- (4) P.K. Kahol, R. Bansal and K.N. Pathak, "Theory of Collective Motions in Liquids," *J. Phys. C: Solid State Physics* 9, L259 (1976).
- (5) K.N. Swamy, P.K. Kahol, D.K. Chaturvedi and K.N. Pathak, "Dynamical Structure Factors in Liquid Na-K Alloys," *Solid State and Nuclear Physics* 19C, 217 (1976).
- (6) K.N. Swamy, P.K. Kahol, D.K. Chaturvedi and K.N. Pathak, "Dynamical Structure Factors in Binary Liquids. I Liquid Na-K Alloy," *J. Phys. C: Solid State Physics* 10, 4191 (1977).
- (7) P.K. Kahol, D.K. Chaturvedi and K.N. Pathak, "Dynamical Structure Factors in Binary Liquids: II. Molten RbBr," *J. Phys. C: Solid State Physics* 10, 4181 (1977).
- (8) P.K. Kahol, D.K. Chaturvedi and K.N. Pathak, "Dynamical Current Correlations in Simple Liquids," *Physica A* 87, 192 (1977).
- (9) P.K. Kahol and D.K. Chaturvedi, "Backflow Effect in Classical Systems," *Physical Review A* 18, 2717 (1978).
- (10) P.K. Kahol, D.K. Chaturvedi and K.N. Pathak, "Dynamical Correlations in Binary Liquids: IV. Fourth Moment of Current and its Applications," *J. Phys. C: Solid State Physics* 11, 4135 (1978).
- (11) P.K. Kahol, D.K. Chaturvedi and K.N. Pathak, "Dynamical Structure Factors in Binary Liquids: III. Molten NaCl," *J. Phys. C: Solid State Physics* 11, 1269 (1978).

- (12) P.K. Kahol and K.N. Pathak, "Collective Motions in Classical Liquids," *Annals of the Israel Physical Society* 2, 796 (1978).
- (13) P.K. Kahol, D.K. Chaturvedi and K.N. Pathak, "Density and Charge Fluctuations in molten Salts," *Annals of the Israel Physical Society* 2, 820 (1978).
- (14) G.S. Dubey, P.K. Kahol and D.K. Chaturvedi, "Charge Fluctuations in KBr," *J. Phys. C: Solid State Physics* 12, L103 (1979).
- (15) N. Boden and P.K. Kahol, "Theory of Deuterium NMR Spin responses," *Chemical Physics Letters* 68, 158 (1979).
- (16) N. Boden and P.K. Kahol, "A Simple Theory of Deuterium NMR Spin Echoes in Solids," *Molecular Physics* 40, 1117 (1980).
- (17) N. Boden, L.D. Clark and P.K. Kahol, "NMR Solid Echoes in Nematic 4-cyano-4'-n-pentyl-d₁₁-2',3',5',6'-d₄-Biphenyl," *Chemical Physics Letters* 93, 95 (1982).
- (18) N. Boden and P.K. Kahol, "NMR Solid Echoes in Systems of Coupled Pairs of Spin-1/2. I. Theoretical Model," *Molecular Physics* 50, 645 (1983).
- (19) N. Boden, L.D. Clark, C.G. Clarke and P.K. Kahol, "NMR Solid Echoes in Systems of Coupled Pairs of Spin-1/2. II. Thermotropic Liquid Crystals," *Molecular Physics* 50, 667 (1983).
- (20) N. Boden, P.K. Kahol, A. Mee, M. Mortimer and G.N. Peterson, "A Simple Spin Echo Experiment for Accurate Measurement of Chemical Shifts in Solids: Application to ¹⁹F in Metal Difluorides," *J. Magnetic Resonance* 54, 419 (1983).
- (21) P.K. Kahol, M. Mehring and X. Wu, "Nuclear Spin- Lattice Relaxation in Trans-Polyacetylene: A Confined Soliton Model Including Nuclear Spin Flip Diffusion," *J. Phys. (Paris)* 46, 1683 (1985).
- (22) M. Mehring and P.K. Kahol, "Magnetic Resonance of Conjugated Polymers," *Springer Series in Solid State Sciences* 63, 264 (1985).
- (23) P.K. Kahol, M. Mehring and X. Wu, "A Confined Soliton Model for Nuclear Spin-Lattice Relaxation in Trans-Polyacetylene," *Springer Series in Solid State Sciences* 63, 271 (1985).
- (24) U. Deininghaus, H. Fischer, P.K. Kahol and M. Mehring, "Application of a Pseudo One-Dimensional Kinetic Ising Model to Proton Spin-Lattice Relaxation Rates in Squaric Acid," *Physical Review B* 31, 3059 (1985).
- (25) P.K. Kahol and M. Mehring, "Exchange-Coupled Pairs Model for the Non-Curie-Like

- Susceptibility in Conducting Polymers," *Synthetic Metals* 16, 257 (1986).
- (26) P.K. Kahol and M. Mehring, "Conjugational Defect in Trans-Polyacetylene and its ESR and ENDOR Lineshapes," *J. Phys. C: Solid State Physics* 19, 1045 (1986).
- (27) P.K. Kahol and N.S. Dalal, "ENDOR Analysis of the Anomalous EPR Lineshapes and the Detection of Cs-(H₄AsO₄) Fluctuations for the AsO₄⁴⁻ Center in CsH₂AsO₄ and CsD₂AsO₄," *Solid State Communications* 65, 823 (1987).
- (28) H. Kass, P. Hoffer, A. Grupp, P.K. Kahol, R. Weizenhoffer, G. Wegner and M. Mehring, "Electron Spin Delocalization in Feast-Type (Durham Route) Polyacetylene: Pulsed ENDOR Investigations," *Europhysics Letters* 4, 947 (1987).
- (29) J. Stankowski, P.K. Kahol, N.S. Dalal and J.S. Moodera, "Possible Josephson Oscillation Spectra and EPR of Cu²⁺ in Y-Ba-Cu-O Superconductor," *Physical Review B* 36, 7126 (1987).
- (30) N.S. Dalal and P.K. Kahol, "Electron Paramagnetic Resonance and Microwave Response in Oxide Superconductors," *Progress in High Temperature Superconductivity* 7, 196 (1988).
- (31) T.A. Mahl, P.K. Kahol, J.P. DeLooze and N.S. Dalal, "Magnetically Modulated Microwave Reflection (MMR) Characterization of High-T_c Superconductors," *Proceedings of High T_c Superconductors: Magnetic Interactions*, Gaithersburg (MD), USA, October 11-13, 1988 published by World Scientific, Singapore (pp. 239-249).
- (32) J. Stankowski, J. Pichet, C.P. Poole Jr., T. Datta, P.K. Kahol, N.S. Dalal, J.S. Moodera, J.E. Drummheller, S.L. Hutton and R.S. Rubins, "EPR and Josephson Absorption in Y-Ba-Cu-O High Temperature Superconductors," *Ferroelectrics* 78, 231 (1988).
- (33) H. Kass, A. Grupp, P. Hoffer, P.K. Kahol, M. Mehring, R. Weizenhofer and G. Wegner, "Pulsed ENDOR Spectroscopy of Stretch-Oriented Feast-Type Polyacetylene," *Springer Series in Solid State Sciences* 91, 184 (1989).
- (34) B. Rakvin, P.K. Kahol and N.S. Dalal, "Electron Nuclear Double Resonance Near the Phase Transitions of the KH₂PO₄-Type of Ferroelectrics," *Molecular Physics* 68, 1185 (1989).
- (35) N.S. Dalal and P.K. Kahol, "Complementarity of ENDOR and ESEEM (Electron Spin Echo Envelope Modulation): ENDOR Detection of Near-Neighbor ³⁹K and ³¹P Couplings for the AsO₄⁴⁻ Center in KH₂AsO₄ and KH₂PO₄," *Solid State Communications* 70, 623 (1989).
- (36) P.K. Kahol and D. Scoular, "Dynamical Investigations of the Gamma- Irradiated CsH₂AsO₄ via EPR, ENDOR and Computer Calculations," *Solid State Communications*

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CITATIONS OF PAPERS IN JOURNALS AS IN 2004

- (1) Approximately 160 citations for the paper: J. Stankowski, P.K. Kahol, N.S. Dalal and J.S. Moodera, "Possible Josephson Oscillation Spectra and EPR of Cu^{2+} in Y-Ba-Cu-O Superconductor," Physical Review B 36, 7126 (1987). J.S. Moodera supplied the sample, and N.S. Dalal was my post-doctoral advisor. J. Stankowski is a Polish professor who was visiting our group in W. Virginia for two months. I benefited from his involvement in finding an interpretation of the data that I had obtained over a period of six months.

High temperature superconductors were discovered in 1986. One of the two physicists who got the Nobel Prize in High Temperature Superconductivity also observed the same phenomenon as we did in our above paper and published his paper in the preceding Physical Review issue.

- (2) 17 citations for the paper: T.J. Hubin, J.M. McCormick, S.R. Collinson, C.M. Perkins, N.W. Alcock, P.K. Kahol, A. Raghunathan and D.H. Busch, "New Iron(II) and Manganese(II) Complexes of Two Ultra-Rigid, Cross Bridges Tetraazomacrocycles for Catalysis and Biomimicry," J. American Chemical Society 122, 2512 (2000). My role was to magnetically characterize the materials for impurities to help Professor Busch's group optimize conditions for better synthesis. All synthesis was done at the University of Kansas by graduate students Hubin, McCormick and Collinson. X-ray characterization was done in the United Kingdom. My contribution in this research is about 20 percent in terms of experiments and analysis.

- (3) 17 citations for the paper: P.K. Kahol, A.J. Dyakonov and B.J. McCormick, "An Electron Spin Resonance Study of Polyaniline and Its Derivatives: Polymer interactions with Moisture," *Synthetic Metals* **84**, 691 (1997).
- (4) 13 citations for the paper: N.J. Pinto, P.D. Shah, P.K. Kahol and B.J. McCormick, "Conducting State of Polyaniline Films: Dependence on Moisture," *Physical Review B* **53**, 1 (1996).
- (5) 11 citations for the paper: N.J. Pinto, C.M. Torres, P.K. Kahol and B.J. McCormick, "Conducting Properties of Polyaniline Blends," *J. Applied Physics* **79**, 8512 (1996).
- (6) 15 citations for the paper: P.K. Kahol, N.J. Pinto and B.J. McCormick, "Charge Transport and Electron Localization in Alkyl Ring-substituted Polyanilines," *Solid State Communications* **91**, 21 (1994).
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- (9) 10 citations for the paper: P.K. Kahol and B.J. McCormick, "Magnetic State of Poly(m-toluidine): Dependence on Absorbed Water," *Physical Review B* **47**, 14,588 (1993).
- (10) 22 citations for the book chapter: P.K. Kahol, W.G. Clark and M. Mehring *Conjugated Conducting Polymers* (Springer Series in Solid State Sciences **102**, 1992) ed. H. Kiess p. 217- 304.
- (11) Extensive citations of research work by Keith Brenneman in his 2001 PhD dissertation submitted to Ohio State University

CITATIONS OF PAPERS IN BOOKS

- (1) Citation in the book "Handbook of Conducting Polymers," 2nd edition, Editors: Skotheim, Elsenbaumer and Reynolds (M. Dekker, New York, 1997) for the paper: P.K. Kahol, V. Pendse, N.J. Pinto, M. Traore, W.T.K. Stevenson, B.J. McCormick and J.N. Gundersen, "Electron Localization Effects on the Conducting and Magnetic States in Polyaniline Copolymers," *Physical Review B* **50**, 2809 (1994).
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- (4) A Figure and some details of this work have appeared in the book "Copper Oxide Superconductors," by Poole, Datta and Farach (John Wiley & Sons, New York, 1988). pp. 166: J. Stankowski, P.K. Kahol, N.S. Dalal and J.S. Moodera, "Possible Josephson Oscillation Spectra and EPR of Cu^{2+} in Y-Ba-Cu-O Superconductor," *Physical Review B* 36, 7126 (1987).
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Published a paper in 1999 with the 2000 Nobel Laureate in Chemistry: K.R. Brenneeman, J. Feng, Y Zhou, **A.G. MacDiarmid**, P.K. Kahol, and A.J. Epstein, "EPR of mesoscale polyanilines," *Synthetic Metals* **101**, 785 (1999).

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- (1) Invited paper presentation: P.K. Kahol, "Electron localization in polyaniline and its derivatives: An electron-spin-resonance study of polymer interactions with moisture," International Seminar on Current Developments in Disordered materials, January 22-24, 1996, Kurukshetra University, Kurukshetra, India.
- (2) Contribute paper presentation (semi-invited): P.K. Kahol, " An electron-spin-resonance study of polyaniline and its derivatives: polymer interactions with moisture," International Conference on Science and Technology of Synthetic Metals, Snowbird (UT), July 28 - August 2, 1996.
- (3) Contributed paper presentation (semi-invited): P.K. Kahol, N.T. Kemp and A.B. Kaiser, "EPR investigations of mesoscopic disorder in polypyrrole," International Conference on Science and Technology of Synthetic Metals, July 15-21, 2000, AUSTRIA.
- (4) Contributed paper presentation (semi-invited): B. Wessling, P.K. Kahol, A. Raghunathan and B.J. McCormick, "ESR and magnetic susceptibility studies of polyaniline and its blend with poly(methyl methacrylate)," International Conference on Science and Technology of Synthetic Metals, July 15-21, 2000, AUSTRIA

ON THE COVER PAGE OF A JOURNAL

A Figure from this paper was reproduced on the cover page of *Synthetic Metals*: P.K. Kahol, K.K. Sathesh Kumar, S. Geetha and D.C. Trivedi, "Effect of dopants on electron localization length in polyaniline," *Synthetic Metals* **139**, 191-200 (2003).

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UNIVERSITY COLLOQUIA

1. Leeds University, England, 1979, 1980, 1981, 1982
2. Universitaet Stuttgart, Germany, 1983, 1984, 1985, 1986
3. University of Liege, Belgium, 1985
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5. West Virginia University, 1986, 1987
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9. Oakland University, 1988
10. Louisville University, 1988
11. Wichita State University (Physics), 1988-2005
12. Pittsburg State University, 1992, 1995
13. Kurukshetra University, 1992
14. University of Missouri-Columbia, 1994
15. University of Kansas, 1995
16. Ohio State University, 1997
17. Bethel College, Newton (KS), 1998
18. Wichita State University (Chemistry), November 1999
19. Louisiana State University, 2000

20. Tulane University, 2000
21. Stuttgart Universitaet, July 2000
22. University of Arkansas, November 2005
23. Southwest Missouri State University (Physics), March 2005
24. Missouri State University (Chemistry), November 2005
25. Panjab University, January 1995, January 2008
26. Materials Science Institute, Bhubaneswar (India), January 2008