October 14, 2011

Dear NSF GRFP Review Committee;

This letter is to recommend Mr. Adam Hehr for the NSF GRFP scholarship. Adam was a student in my Measurements and Instrumentation Lab undergraduate class in the spring of 2010. He was one of the strongest students in my class and was very curious about the significance and impacts of sensing. Adam asked me last spring about potential structural health monitoring (SHM) graduate work after he learned of my work with commercialization of carbon nanotubes (CNTs). Consequently, I’ve been discussing the possibility of developing an embedded SHM sensor architecture for composite material for about six months with him. The sensor he proposed himself would be made of spun carbon nanotube thread and interwoven into the composite material. As a result, this technique is noninvasive to the composite material. Other embedded sensing techniques add stress concentrations that might cause premature material failure. Additionally, this sensor concept is robust, simple, cost effective, and can add other functionality such as strength enhancement and de-icing to aircraft. I believe the research Adam proposes has the potential to be used in military and commercial aircraft inspection that will in turn save time, money, and human lives. This is especially important because the commercial aircraft industry is moving toward large scale use of composite materials.

This CNT thread sensing research will be conducted at the University of Cincinnati’s Nanoworld and Smart Materials & Devices laboratories. These laboratories are equipped with state of the art instrumentation, carbon nanotube reactors, nanomaterial characterization equipment such as a scanning electron microscope, and a CNT thread spinning machine for in house thread fabrication. Additionally, these laboratories work closely with other nanomaterial laboratories including labs overseas along with government agencies. The work Adam will do will be highly visible. His results will be disseminated through publications and through an international collaboration on SHM led by the University of Molise, Italy, that Nanoworld is participating in. Nanoworld is participating because we have the nanotube thread material and expertise in health monitoring of composites. Also, many researchers from all over the world visit the Nanoworld Lab. Nanoworld’s website is among the university’s most highly visited sites. Hundreds of international students inquire about studying at the University of Cincinnati working in the Nanoworld lab. I would like to increase the number of American students working in Nanoworld. Academically, Adam ranks among the top of the foreign applicants to Nanoworld and I would like to see Adam and more Americans in University research labs. Adam is an excellent candidate to pursue the PhD degree and become a faculty member in engineering.

Adam is sincerely interested in helping others. I know he will be a team player in the research, which is highly interdisciplinary. He also wants to participate in outreach and teaching younger students. Nanoworld is involved in several outreach programs to undergraduate and high school students including several close-by intercity high schools, including all girl schools. We do our best to show these students what kind of work takes place in university laboratories and get them interested in nanotechnology and research. Adam’s idea is to develop modules from our labs to teach at the high school level to draw students to college. To start, Adam proposes
to invite Hughes High School to participate in lab modules. Hughes is a nearby inner city science, technology, engineering, and mathematics high school. In addition to letting high school students work in the Nanoworld Lab, a specialized nano seminar class might be taught at Hughes to complement and reinforce lab work. Other high schools will also be invited to participate in the lab modules. I particularly think we need to involve the academically “in-trouble” high schools more, not just the top STEM schools in our area. There are a few high schools in Cincinnati that have trouble meeting the State of Ohio Graduation Standards. We will tailor our modules to be at a level to teach students basic principles while drawing their interest in engineering.

Besides our work in the lab, we also host an annual Nanotechnology Materials and Devices workshop with the assistance of the Air Force Research Laboratory in nearby Dayton, OH. This past year, many of the world’s nanomaterial researchers attended. This workshop offers a great opportunity to disseminate research and start collaborations with labs all over the world. We are very proud that this workshop is so popular and continues to grow. Adam will present his research findings at this workshop.

Adam’s research potential is very strong and unique. Adam’s cooperative education internships involved working with a very successful small research company here in Cincinnati called Etegent, along with working with an SHM group at Los Alamos National Laboratory. Etegent is co-owned by one of my friends and previous university colleagues, Stuart Shelley. One of Etegent’s core competencies is sensor development and I know that Adam has actively developed sensors for SHM and control engineering applications for the Air Force and Navy while interning there. Additionally, Adam sought out the SHM group at Los Alamos. It just so happens that I’m fairly familiar with this Los Alamos group and I personally know the director, Charles Frarr. While at Los Alamos Adam learned strong research skills in SHM related fields that will undoubtedly aid in this proposed research.

Adam is well qualified for the NSF Scholarship because of the high intellectual level and practical impact of his research program, and because of his interest in the broader good of the research. I would be honored to advise Adam and help produce a future new nano-engineering faculty member.

Sincerely,

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