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**Opportunities for a Professional Science Masters degree program in Nanoscience**

With the rapid development of nanotechnology there is a tremendous need for government leaders and industrial managers and research strategists with a grounding in nanoscale science, nanotechnology applications, and professional knowledge of intellectual property and innovation development and assessment. The impact of nanotechnology extends across large and small companies and innovation most often begins in start-up companies.

At ASU a new Professional Science Masters (PSM) program in Nanoscience has been established collaboratively by the Department of Physics and the Department of Chemistry and Biochemistry. Both Departments have strong research programs and faculty expertise in nanoscience and nanotechnology. The faculty leadership provides opportunities for student mentoring and pre-existing courses in areas of nanoscience and nanotechnology.

The PSM-Nanoscience degree program consists of interdisciplinary courses that provide a knowledge base required for full appreciation of research and innovation in Nanoscience and Nanotechnology. Students choose courses in physics, chemistry and biochemistry, materials science, biotechnology, and intellectual property and innovation.

This presentation describes the structure of the ASU Professional Science Masters program in Nanoscience, the related research, the development of the courses that underpin the program, and the progress of students in the program.

**Thermionic Electron Emission from Diamond Films for Solar and Thermal Energy Conversion**

Direct conversion of heat into electrical energy based on thermionic energy conversion may provide a highly efficient approach for waste energy and also for solar energy conversion. The process can occur over temperature ranges from 500 to over 2000°C. The highest temperature operation would reflect focused solar applications and the lower temperature operation would be for waste heat or unfocused solar applications. This study presents new approaches for energy conversion through the use of doped diamond films in a novel vacuum gap configuration that combines effects related to thermionic electron emission, molecular charge transport and direct photo excitation.

Thermionic electron emitters based on diamond require control of the surface electron affinity, doping levels and concentration, and band bending. It is now well established that H-terminated diamond surfaces result in a negative electron affinity where the vacuum level is located below the conduction band minimum (CBM). It appears that optimized nanocrystalline films result in a low film resistance and control of band bending. Significant thermionic electron emission has been measured at temperatures less than 500°C from engineered multilayered structures of nitrogen doped, nanocrystalline diamond films.

In a novel approach, we have amplified the electron emission by utilizing surface ionization processes where charge is transferred from the conduction band of the emitter surface to the negative ionization level of the scattered molecule. It has been shown that the negative electron affinity of diamond surfaces can provide efficient means for charge transfer as electrons can readily be released into vacuum. Here, we present results on electron emission from nitrogen and phosphorus doped diamond films in a variable environment of gaseous species where a significant enhancement of the emission characteristics is observed.

The electron emission can be further enhanced with the application of visible light. Results are presented that indicate the potential for combined photo and thermionic emission in an energy conversion configuration. These emission enhancing phenomena can be utilized in a thermionic/molecular/photo energy converter configuration and our analysis indicates a high efficiency at operating temperatures of ~ 500°C.