UNH Materials Science Seminar

11:10-12:00, Thursday, Nov. 29, 2007
Kingsbury Hall S145
University of New Hampshire

Fabrication of Silicon Carbide AFM Cantilevers

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There is growing interest in AFM cantilevers with resonant frequencies in the range of MHz or higher, as motivated by the desire to scan samples at higher frame rates (video rate and above). Such high-speed AFM systems would allow more rapid sample analysis and quality control in high-rate nanomanufacturing processes. The great majority of commercial cantilevers, however, are limited to resonant frequencies of hundreds of kHz. A common approach to increase the resonant frequency is to shorten the cantilever's length. This approach, however, results in the undesirable increase in the stiffness of the cantilever, reducing the sensitivity of the instrument. We have developed an alternative approach: The fabrication of AFM probes composed of SiC via polymer molding. A novel two-step process is used wherein the probe is initially molded as a pre-ceramic polymer through the use of a crosslinkable liquid resin of the polysilane / polycarbosilane type, then thermally converted to SiC via pyrolysis under inert atmosphere. Using this technique, we have been able to replicate nanoscopic features with high fidelity, and successfully retain those features through each step of the process. This method has the potential to produce alternative geometries inaccesible via standard lithographic techniques. Additionally, the technique of molding preceramic nanostructures in polymer form takes advantage of a vast body of knowledge related to the rapid and economical molding of plastic parts, and represents a significant advance in our ability to perform nanomanufacturing of ceramics (extensible to a range of other preceramic polymers).

Joel Therrien received his Ph.D. in Physics from the University of Illinois at Urbana-Champaign in 2002. He worked as a postdoctoral fellow at the NASA Institute for Nanoelectronics and Computing at Purdue University, working on UHV and RF Scanning Tunneling Microscopy techniques. He joined the department of Electrical and Computer Engineering at the University of Massachusetts Lowell as an assistant professor in the fall of 2005. His research interests include nanomaterial-based optical and mass sensors, high speed AFM, and graphene synthesis.

Host: Professor Glen Miller