EE 298-12
Solid State Technology and Devices Seminar

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1-2pm
Hogan Room - 521 Cory Hall

Application of Inkjet-Printing Technology to Micro-electro-mechanical Systems

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ABSTRACT:
Printed electronics employing solution-processed materials is considered to be the key to realizing low-cost large-area electronic systems, but the performance of printed transistors is not generally adequate for most intended applications due to limited performance of printable semiconductors. In this talk, I propose an alternative approach for a printed switch, where the use of semiconductors can be avoided by building mechanical switches with printed metal nanoparticles. I provide the first demonstration of inkjet-printed micro-electro-mechanical (MEM) switches with abrupt switching characteristics, very low on-state resistance (~10 Ω), and nearly perfect off-state behavior with immeasurable leakage with on/off current ratio of 10^7. The devices are fabricated using a novel process scheme to build 3-dimensional cantilever structures from solution-processed metallic nanoparticles and sacrificial polymers. These printed MEM switches thus represent a uniquely attractive path for realizing printed electronics. I will also discuss an inkjet-printed microshell encapsulation as a new zero-level packaging technology. Inkjet-printing of silver nanoparticle ink is demonstrated to form porous microshells through which sacrificial oxide can be selectively removed to release MEMS structures. A second inkjet printing process using finer gold nanoparticle ink or polymer is demonstrated to effectively seal the microshells. This inkjet-printed microshell encapsulation technology is successfully applied to a MEM relay, and is demonstrated to mitigate the issue of contact oxidation. Specifically, the stability of the relay ON-state resistance is dramatically improved by more than a factor of 100.