Carnegie Mellon
Materials Science and Engineering Seminar Series
Materials Research at Carnegie Mellon

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"*Recrystallization of Copper in Restricted Geometries*"

Friday, December 8, 2006
11:00 A.M. Seminar in Doherty Hall 1212
Refreshments precede seminar at 10:30 A.M. in 2325 Wean Hall

In the past decade, the progression from aluminum to copper wiring in semiconductor integrated circuits required a number of concomitant materials developments. One of the most significant changes was the adoption of the damascene process to create interconnects, wherein the wires are inlaid into a previously patterned isolation dielectric via electrochemical deposition (ECD). The high nucleation density of ECD films, however, leads to a very fine grain structure which recrystallizes – even at room temperature – within a matter of hours or days. In the increasingly aggressive geometries employed for advanced interconnects this recrystallization front is impeded, leaving a polycrystalline structure which adversely affects the performance and reliability of advanced integrated circuits. Conflicting reports in the literature leave some doubt as to whether the recrystallization is driven by surface energy, strain energy or mere abnormal grain growth. We have therefore begun a series of systematic experiments using cryogenic storage to retard recrystallization, enabling us to study the kinetics of this rapid transformation. Preliminary results suggest that both the driving force and dominant mechanism for recrystallization are strongly influenced by the specific geometry of the features of interest. Such studies lay the foundation for practical amelioration strategies for the inducement of bamboo structure in narrow lines and vias.

Kathleen Dun received her B.S. from Cornell in 1991, and her Ph.D. from the University of Wisconsin at Madison in 2001. She joined the University at Albany at the State University of New York as a post-doc, spent two years as a staff scientist, and became a founding faculty member of the nascent College of Nanoscale Science & Engineering. Her expertise in transmission electron microscopy has led to research in a number of materials fields, including gallium nitride, carbon nanotubes and electroplated copper. Her more fundamental research interests include the interactions of charged particle beams with matter and the development of new microscopy techniques including cryo-FIB and phase plate imaging in the TEM.