

Career: Fundamental Metal Oxidation Kinetics Visualized by In situ UHV-TEM

Judith C. Yang, University of Pittsburgh, DMR-013479

GOAL: Understanding oxidation at the nanoscale, by primarily *in situ* ultra high vacuum transmission electron microscopy (UHV-TEM) for dynamic oxidation kinetics under well-controlled surface conditions.

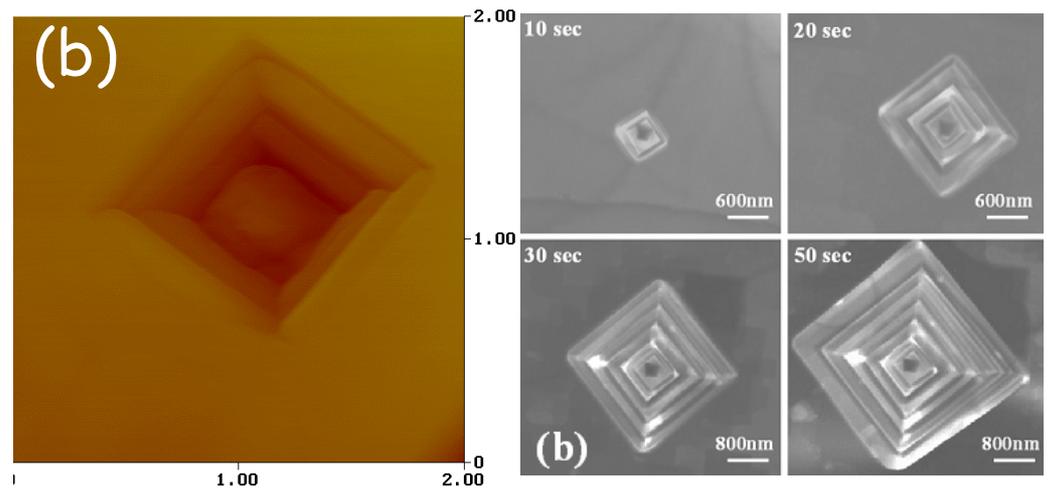
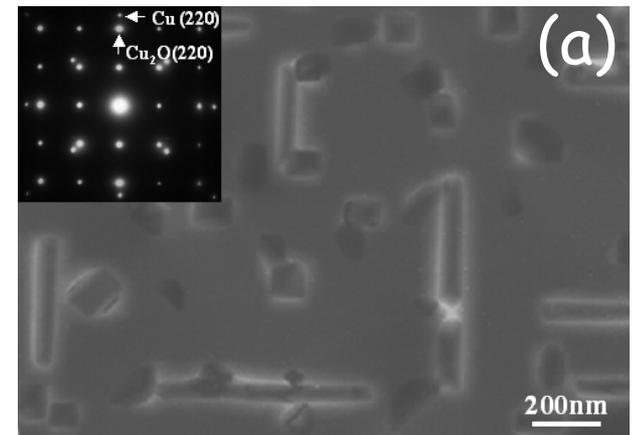
IMPACT

» environmental stability at the nanoscale, that is essential for the durability of nanodevices.

» processing of nanoscale oxides, such as in semiconductor devices, magnetic materials, biological templates, and superconducting material.

» fuel cells, catalysis, corrosion.

» New paradigm for metal oxidation based on "heteroepitaxy" (thin film growth), where surfaces and strain control oxidation mechanisms.



As an example of nanoprocessing, oxide "nanorods" (figure a) and "nanocontainers" (figure b) are created at selective oxidation conditions of Cu(100) *in situ*. (Phys. Rev. Lett, 89 (10) 2002)

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Brief Summary of Outreach

Education:

Undergraduate Students:

Joe Laughlin, Daniel Evan, Lori Tropa, Erin Devlin and Anu Gupta contributed to this research program as summer research experience and/or as senior projects. D. Evan was awarded the ASM award for "Best Senior" in Spring 2003. L. Tropa won 2nd place in the ASM-TMS student poster competition. A journal publication resulted from L. Tropa's and D. Evan's senior projects (Applied Physics Letters, 2002, 81 p.241-3).

A. Gupta is pursuing graduate studies in Materials Science and D. Evan is in the graduate program of Science Education at the University of Pittsburgh. E. Devlin is in the graduate program at the University of Colorado.

Graduate Students:

Guangwen Zhou and Liang Wang contributed to this research program. G. Zhou will receive his PhD in 2003 and will continue oxidation studies as a post-doc at Argonne National Laboratory. G. Zhou was the recipient of the 2002 Materials Research Society Silver Graduate Student Award.

Curriculum Development:

A new course, "Thin Films and Characterization", was developed and taught in Fall 2002 for graduate students at the University of Pittsburgh. In 2004, this thin films course will also be available as a technical elective to undergraduate seniors.