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Flow stabilization in submicron-sized copper crystals by introducing high angle boundaries

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(Credit: ©Marc Cramer)

Controlled Synthesis, Processing, and Applications of Structural and Functional Nanomaterials — Session I

Program Organizers: Gurpreet Singh, Kansas State University; Kathy Lu, Virginia Tech; Eugene Olevsky, San Diego State University; Nitin Chopra, University of Alabama; Edward Gorzkowski, Naval Research Laboratory; Sanjay Mathur, University of Cologne

Monday PM
October 28, 2013

Room: 512f
Location: Palais des Congres de Montreal

Session Chairs: Kathy Lu, Virginia Tech; Gurpreet Singh, Kansas State University

2:00 PM Invited

Roughening Instability during Coating for Nanoscale Solution-derived Thin Films: *Dunbar Birnie*¹; ¹Rutgers University

2:40 PM Invited

Self-assembled Semiconductor 0D, 1D and 2D Quantum Structures in a Nanowire for Advanced Bandgap Modulation: Growth, Structural Modeling and Optical Properties: *María de la Mata*¹; *Francisco Belarre*¹; *Jordi Arbiol*¹; ¹ICREA and Institut de Ciència de Materials de Barcelona, ICMAB-CSIC

3:20 PM Break

3:40 PM

Role of Catalyst Dissolution in Shaping VLS Grown Nanowires: *Dany Chagnon*¹; *Oussama Moutanabbir*¹; ¹Polytechnique Montréal

4:00 PM

Isotopically Engineered Silicon Nanowires: *Samik Mukherjee*¹; *Oussama Moutanabbir*¹; ¹Ecole Polytechnique de Montreal

4:20 PM Invited

Our Hair Reacts to a Charged Carpet or Static Electricity - So Does Nanomorphology in Organic Photovoltaic Films: The First Demonstration: *Moneim Elshobaki*¹; *Sumit Chaudhary*¹; ¹Iowa State University

5:00 PM Invited

Eight Two-Dimensional Transition Metal Carbides:

Adding Two New Members to the MXenes Family: *Michael Naguib*; *J. Halim*¹; *J. Lu*²; *L. Hultman*³; *Michel Barsoum*; *Yuri Gogotsi*⁴; ¹Drexel University; ²IFM Linköping University; ³IFM Linköping University; ⁴Drexel Univ

5:20 PM

Hybrid Aerogel/Nanorod Functional Materials for Energy and Sensing Applications: *Derek Miller*¹; *Pat Morris*¹; *Sheikh Akbar*¹; ¹Ohio State University

5:40 PM

Growth of Binary and Ternary Tungsten Oxide Nanowires with Large Aspect Ratios for Smart Device Applications: *Tao Sheng*¹; *Baobao Cao*²; *Haitao Zhang*²; ¹Department of Physics and Optical Science, UNC Charlotte; ²Department of Mechanical Engineering and Engineering Science, UNC Charlotte

Deformation and Transitions at Grain Boundaries III — Mechanical Deformation and Failure of Grains and Grain Boundaries II

Program Organizers: Thomas Bieler, Michigan State University; Rozaliya Barabash, MST Div; Doug Spearot, University of Arkansas; Jian Luo, Sch Mat Sci & Engr, ; Shen Dillon, Dept Mat Sci & Engr

Monday PM
October 28, 2013

Room: 511f
Location: Palais des Congres de Montreal

Session Chairs: Fionn Dunne, Imperial College; Philip Eisenlohr, Michigan State University

2:00 PM Invited

Stresses near Grain Boundaries in Deformed Polycrystals: *Jun Jiang*¹; *T Britton*²; *Angus Wilkinson*¹; ¹University of Oxford; ²Imperial College London

2:20 PM Invited

Changes in Deformation Resistance of Cu with Variations between Low and High-angle Dominated Grain Boundary Character: *Philip Eisenlohr*¹; *Jiri Dvorak*²; *Petr Kral*²; *Vaclav Sklenicka*²; *Wolfgang Blum*³; ¹Max-Planck-Institut für Eisenforschung; ²Academy of Sciences of the Czech Republic; ³Universität Erlangen-Nürnberg

2:40 PM Invited

Flow Stabilization in Submicron-sized Copper Crystals by Introducing High Angle Boundaries: *Xiaodan Zhang*¹; *Xiaoxu Huang*¹; *Niels Hansen*¹; ¹Technical University of Denmark

3:00 PM Invited

Characterization of Grain Boundary Effects on Material Damage Evolution: *John Bingert*¹; *Veronica Livescu*¹; *Ricardo Lebensohn*¹; *Brian Patterson*¹; *Cheng Liu*¹; *Thomas Mason*¹; ¹Los Alamos National Laboratory

3:20 PM Break

3:40 PM Invited

Micromechanics of Dislocation Channeling and IGSCC in Irradiated Stainless Steels: *Gary Was*¹; *Michael McMurtrey*¹; *Ian Robertson*²; *Bai Cui*²; *Diana Farkas*³; *Laura Patrick*³; ¹University of Michigan; ²University of Illinois; ³Virginia Tech

4:00 PM

Dislocation Density Distributions in Deformed Polycrystals: *Jun Jiang*¹; *T Britton*²; *Angus Wilkinson*¹; ¹University of Oxford; ²Imperial College London

4:20 PM

Fracture Toughness of Nanocrystalline Ni-W Films: *Wanjun Cao*¹; *Yuanyao Zhang*²; *Jian Luo*²; *Richard Vinci*¹; ¹Lehigh University; ²University of California, San Diego

4:40 PM Invited

Microstructure-sensitive Fatigue Crack Nucleation Criteria in Ferritic Steels: *Fionn Dunne*¹; *Victor Wan*¹; ¹Imperial College

5:00 PM Invited

Silicon Nitride-graphene Composites with Improved Strength and Toughness Processed from Low Concentrations of Few Layer Graphene Using SPS: *Luke Walker*¹; *Victoria Marotto*¹; *Mohammad Rafiee*²; *Nikhil Koratkar*²; *Erica Corral*³; ¹The University of Arizona; ²Rensselaer Polytechnic Institute; ³The University of Arizona

Flow stabilization in submicron-sized copper crystals by introducing high angle boundaries

Xiaodan Zhang, Xiaoxu Huang and Niels Hansen

Danish-Chinese Center for Nanometals, Materials Science and Advanced Characterization Section, Department of Wind Energy, Risø Campus, Technical University of Denmark, DK-4000 Roskilde, Denmark

The presence of high angle boundaries in a metal affects both the plastic behavior and the strength. This is explored in copper crystal pillars with sizes around 200nm prepared by focused ion beam. Pillar 1 is a single crystal while pillar 2 and pillar 3 contain one and three high angle boundaries, respectively. Low yield stress and large stress drops were observed in pillar 1, but small drops are present in pillar 2 and 3. The existence of high angle boundaries in pillar 2 and 3 removes the large stress drops by preventing the escape of dislocations from the pillar and the presence of these boundaries increases the stress of crystals 2-3 times. The significant effect of grain boundaries in the crystals is analyzed by combining the observation of microstructure, crystal rotation and strength as a function of the plastic strain.

References

- [1] Xiaodan Zhang, Andrew Godfrey, Grethe Winther, Niels Hansen, Xiaoxu Huang. Plastic deformation of submicron-sized crystals studied by in-situ Kikuchi diffraction and dislocation imaging. *Materials Characterization*, 2012;70:21-27.
- [2] Xiaodan Zhang, A Godfrey, Grethe Winther, Niels Hansen, Xiaoxu Huang. In-situ TEM compression of submicron-sized single crystal copper pillars. *Risoe International Symposium On Materials Science. Proceedings 31*. 2010. P. 489-496.