

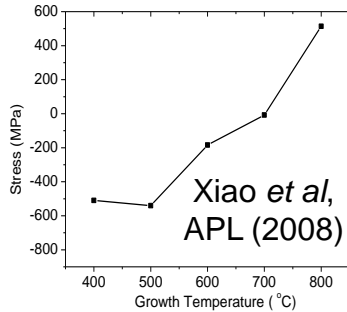
Grain Boundary Induced Stresses in Nanocrystalline Ceramic Coatings and Thin Films

Brian W. Sheldon, Janet Rankin (Brown University), Barbara Walden (Trinity College)

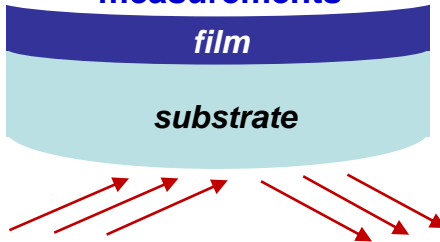
Nanocrystalline Diamond

Stress During CVD Growth:

Large Impact of Grain Bdry Chemistry & Structure



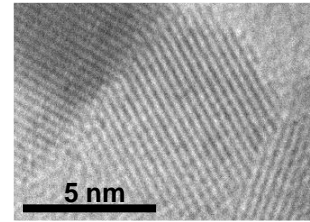
In situ film stress from optical curvature measurements



Non-Stoichiometric Oxides

Stress Due to O Variations in CeO_{2-x}

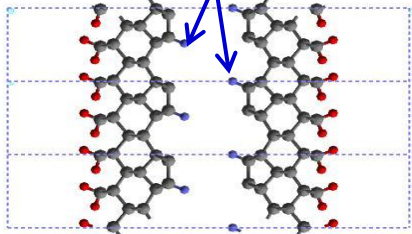
Grain Bdry Contributions Dominate Stress



Nanocrystalline CeO_{2-x} deposited from Ce(thd)₄

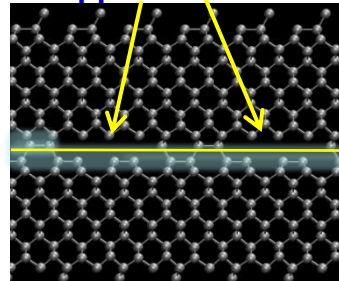
DFT Calculations (w. Yue Qi at GM)

Trapped Hydrogen

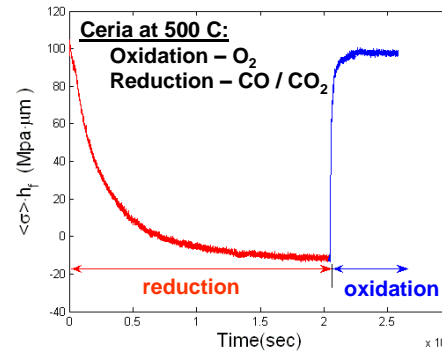


Qi et al, PRL (2009)

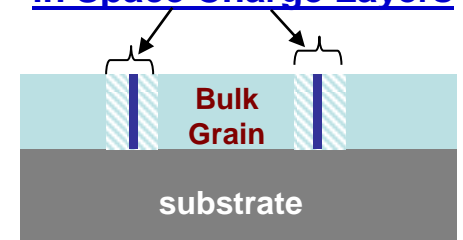
Trapped Nanovoids



Milas et al, JAP (2011)



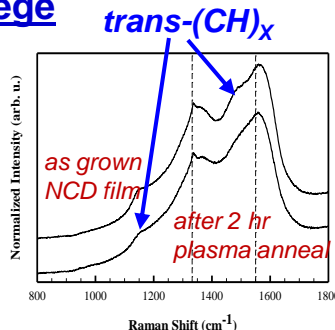
Large Local Stresses (up to 10 GPa!) in Space Charge Layers



Sheldon, PRL (2011)

Trinity College

- faculty involved in research (Raman)
- Trinity undergrads working at Brown



Broader Impacts

General Motors

- interest in low friction NCD coatings
- DFT (see above)
- use of GM facilities

Institute National Polytechnique – Toulouse (France)

- H and OH induced stresses in protective alumina coatings (on Ti alloys)
Soni et al, ECS Trans (2010)
- extensive student and faculty exchanges

DMR-Award 0805172