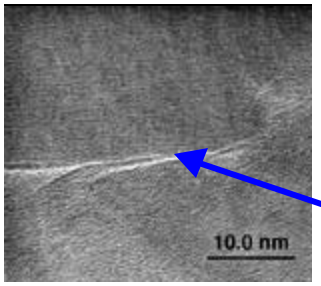
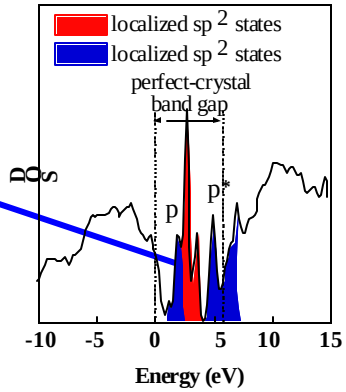
Studies of Electron Field Emission Phenomena in Ultrananocrystalline Diamond and Low Work Function Cu-Li Alloy Thin Films

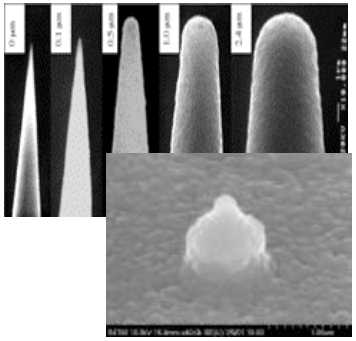
Electron Field Emission from UNCD



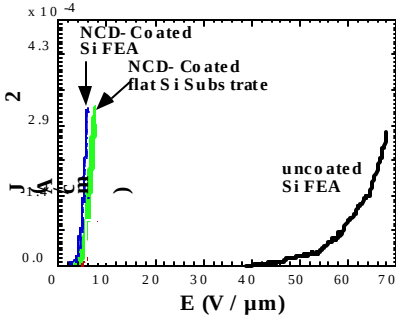


UNCD films are formed by 2-5 nm equiaxed grains and 0.2-0.5 nm grain boundaries that play a critical role in FE

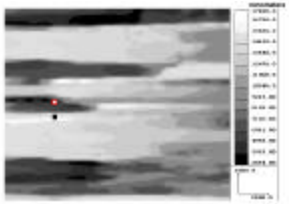
Computer simulations revealed sp^2 - bonded gap states in UNCD grain boundaries

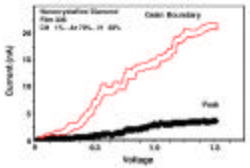


Conformal UNCD coating on high- & low- aspect ratio Si field emitter tips

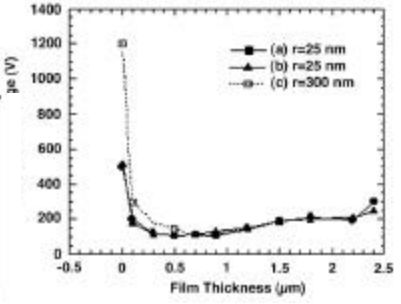


I vs. E curves for uncoated, UNCD-coated Si - field emitters & planar Si surface show extremely low threshold field for UNCD-coated Si





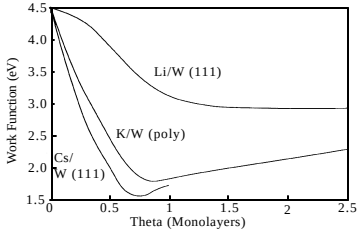
STM topographical image and associated electron emission (red) measured from region close to UNCD grain boundary (dark in STM image)



Threshold emission field vs. UNCD coating thickness on Si field emitters shown above

I vs. E, threshold emission vs. film thickness, STM emission data, and computer Simulation indicate that grain Boundaries play critical role In FE from UNCD

Electron Field Emission from Cu-Li Alloys

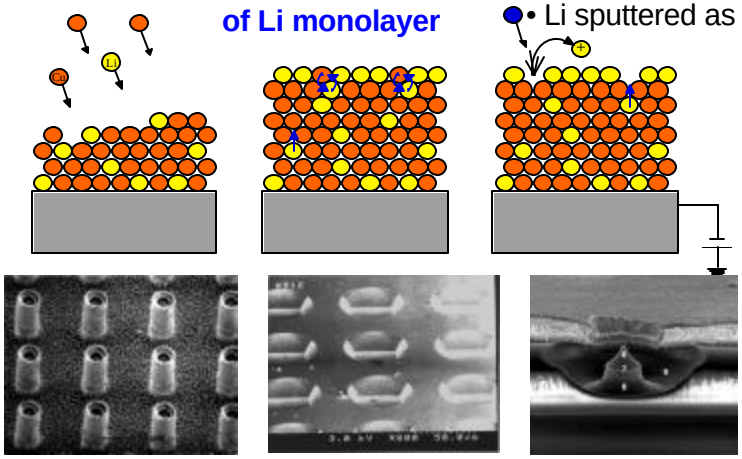


- Charge transfer between segregated surface alkali Li layer and Cu-Li alloy substrate:
  - ☑ Reduces work function
  - ☑ Modeled by formation of surface dipoles

Magnetron Deposition

Gibbsian segreg. induces formation of Li monolayer

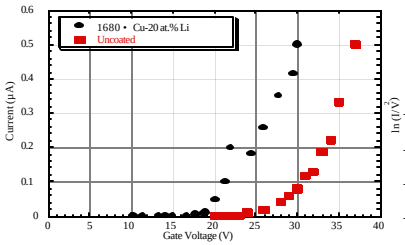
Self-sustaining
- low Li sputter yield
- Li sputtered as Li^+



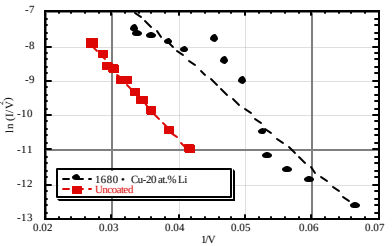
Vert. Cu-Li edge emitter

Horiz. Cu-Li edge emitter

Gated Cu-Li micro-tip



I vs V for gated Cu-Li tip



Fowler-Nordheim curve