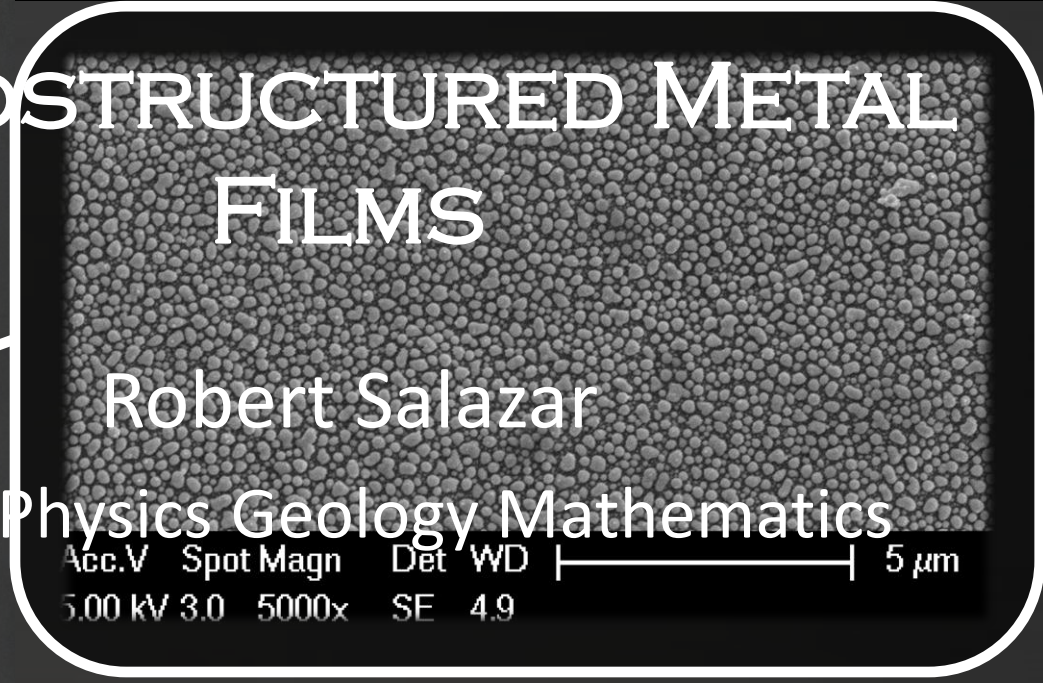
In

Nanostructured Metal Films

Robert Salazar

Physics Geology Mathematics

SBCC SANTA BARBARA CITY COLLEGE



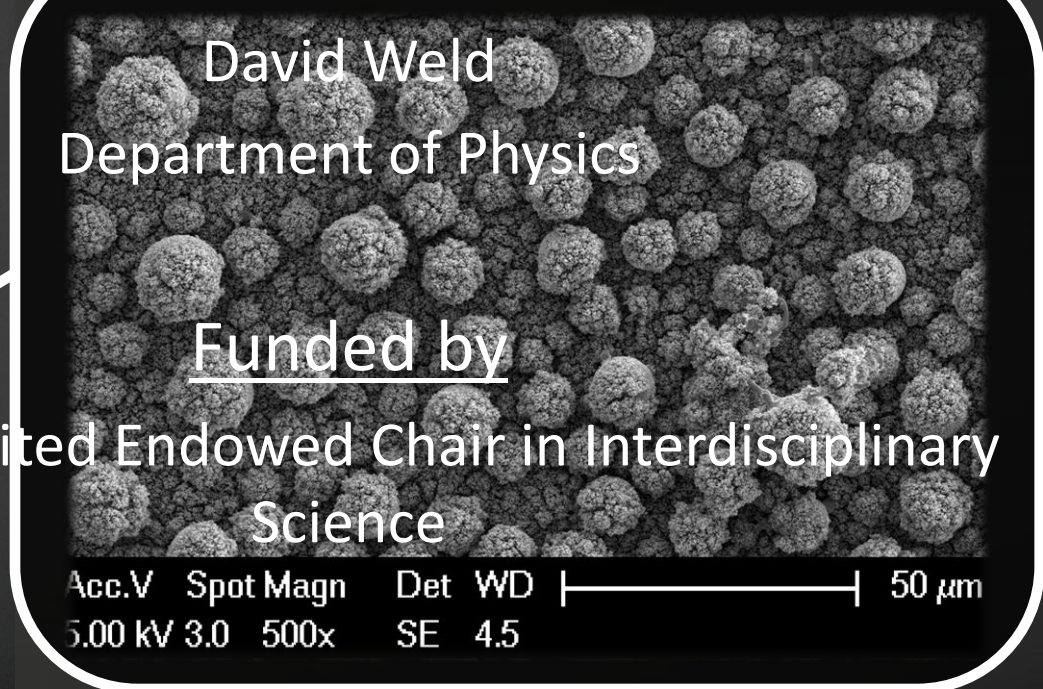
Advisor and Mentor

David Weld

Department of Physics

Funded by

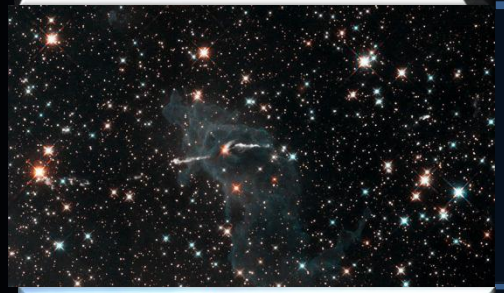
Richard Whited Endowed Chair in Interdisciplinary Science



Nanostructured Metal Films

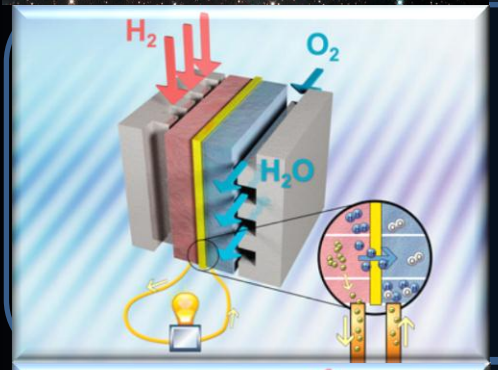
Condensed Matter Physics

Superconductivity: Variances in structural disorder enhance superconductivity in thin metal films.



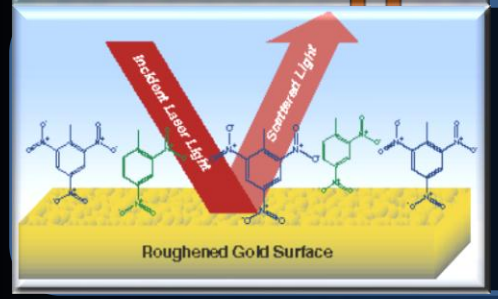
Cosmology and Astrophysics

Near Infrared Photometry: Higher resolution infra red images for mapping the universe



Chemistry

Catalysis: Thin film's low mass and high surface area may be very useful for solid state catalysis



Biology

Surface-Enhanced Raman Spectroscopy: Detect and identify individual molecules that bind to the film's surface.

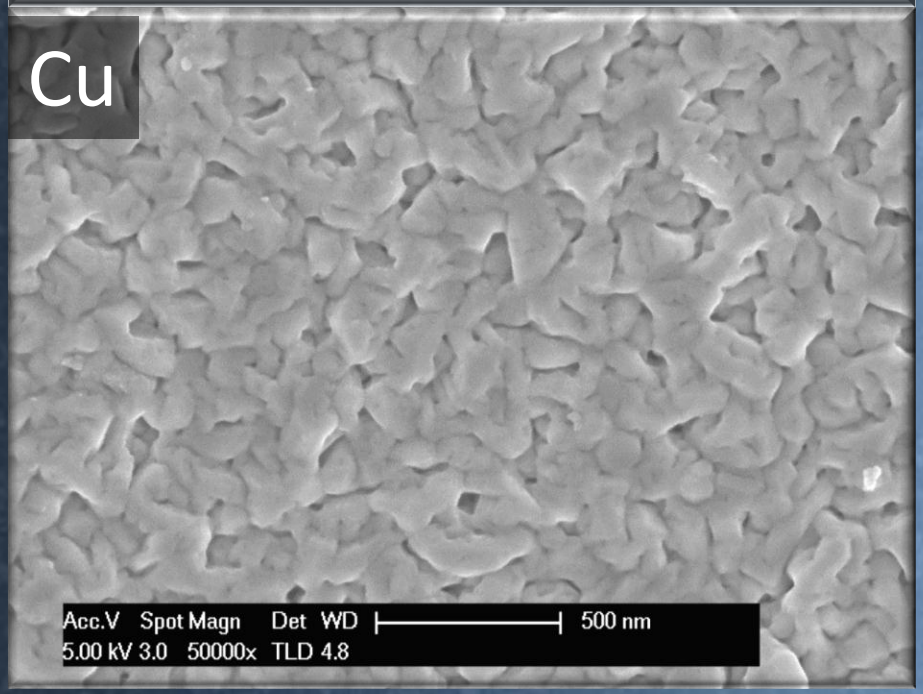
Research Directive

Deposition PARAMETERS DETERMINE Morphology

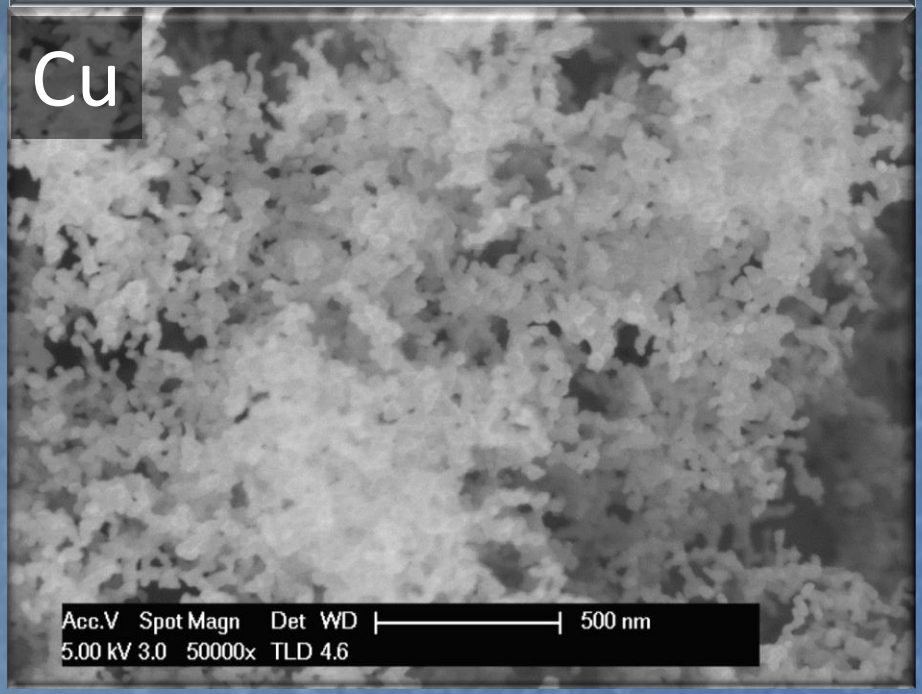
Morphology DETERMINES Properties

- Vary the deposition parameters
- Characterize the morphology
- Discover and Analyze the resulting properties
- Search for applications

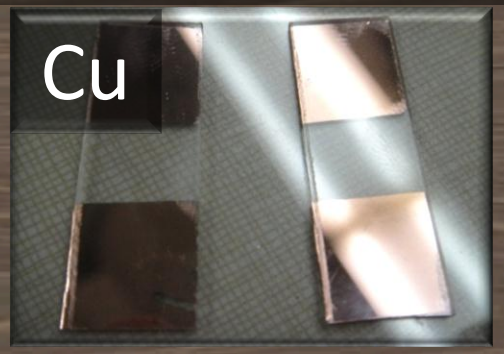
.00001 Torr Argon Pressure

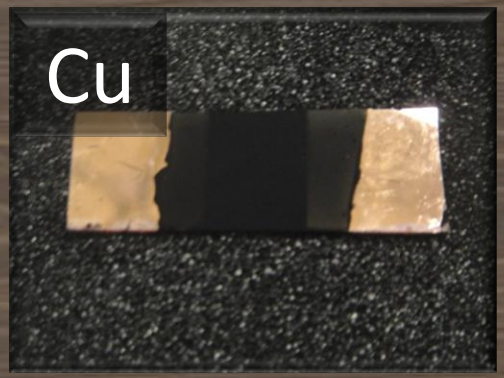


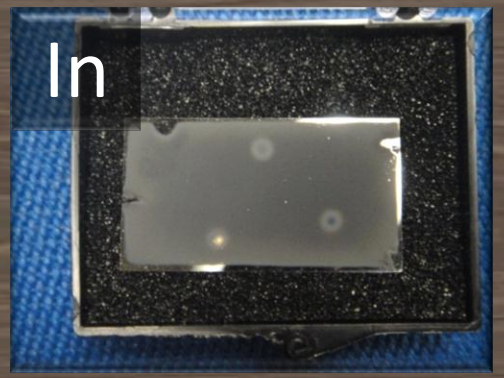
4 Torr Argon Pressure

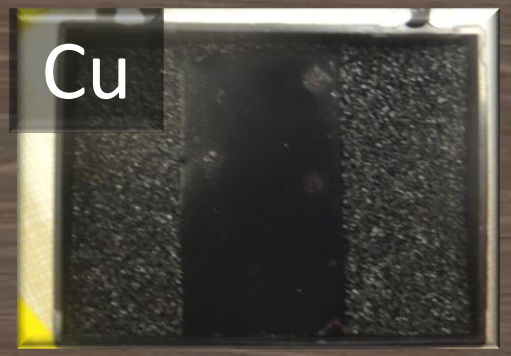


Creator & Creations

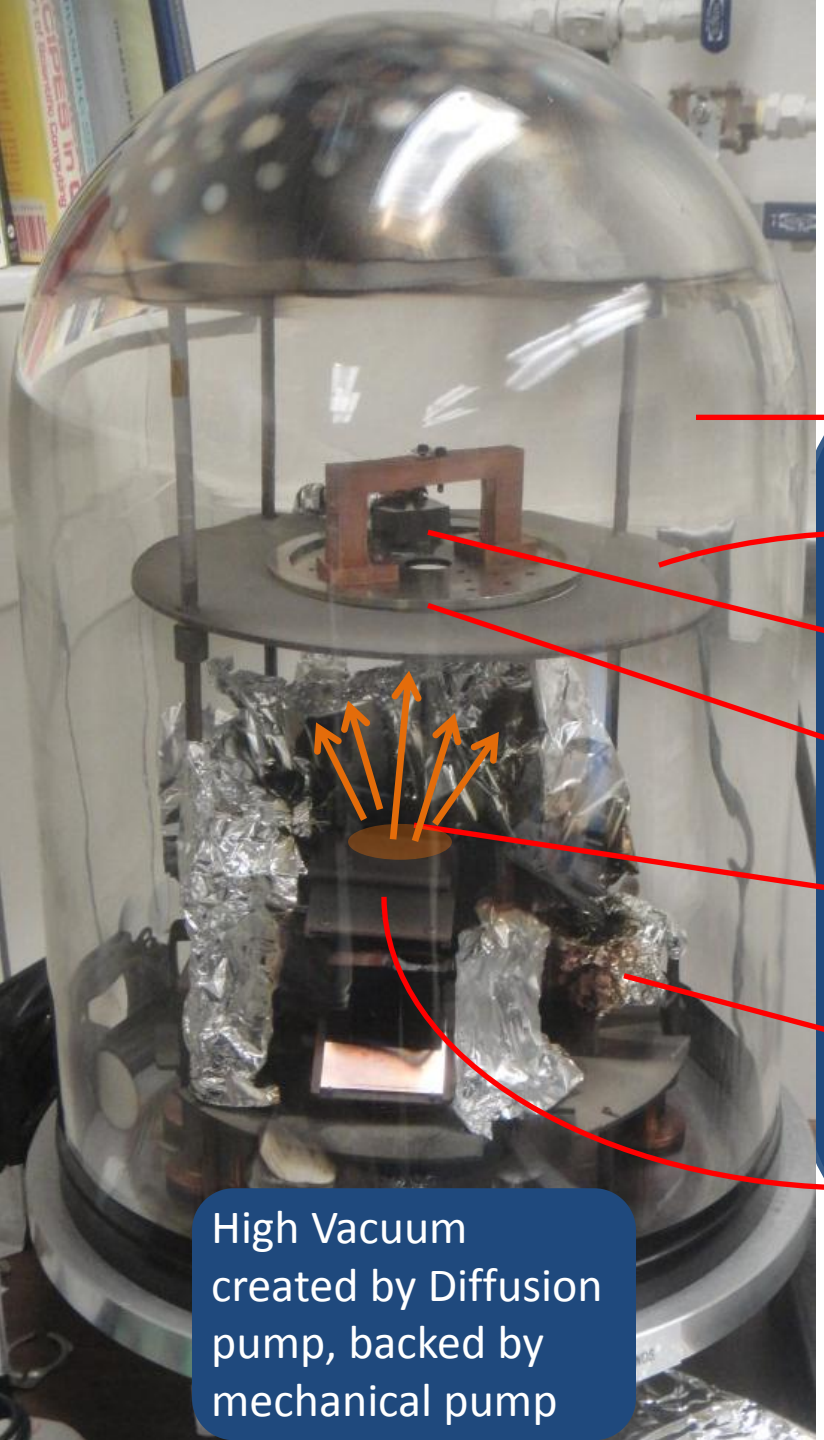








Thin Films
The Deposition Apparatus



Glass Bell Jar

Substrate Table

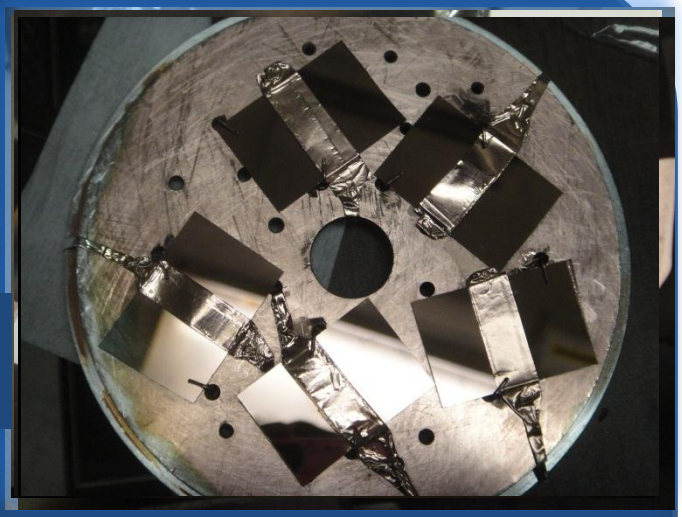
Crystal Detector

Subtrate Holder and Sample

Path of Vapor

Clamps Connected to High Current Source

Boat filled with Copper

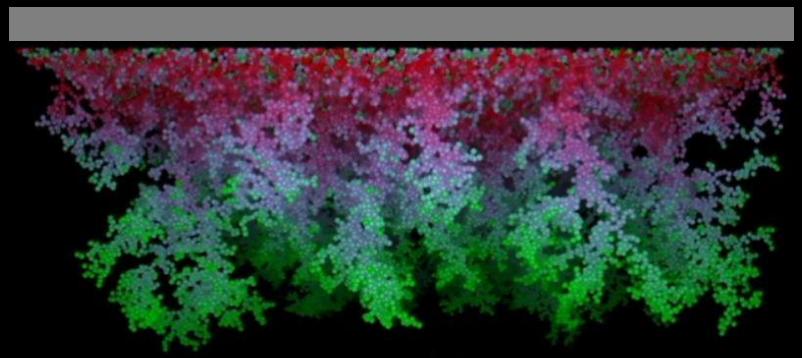


High Vacuum created by Diffusion pump, backed by mechanical pump

~5 Torr Deposition Simulation

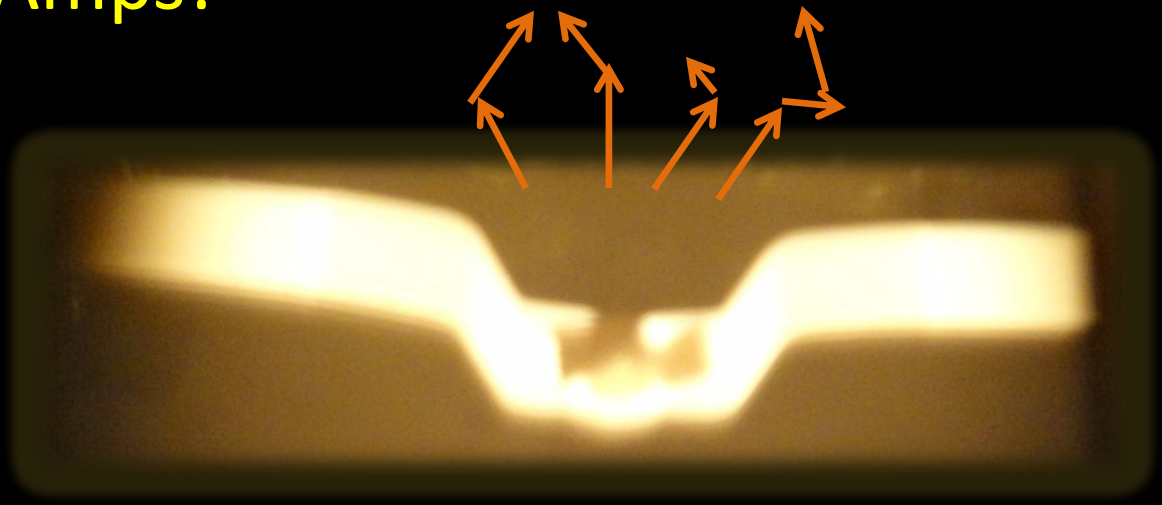
220 Amps!

~5 Torr Deposition Simulation



Diffusion Limited Aggregation by khyar

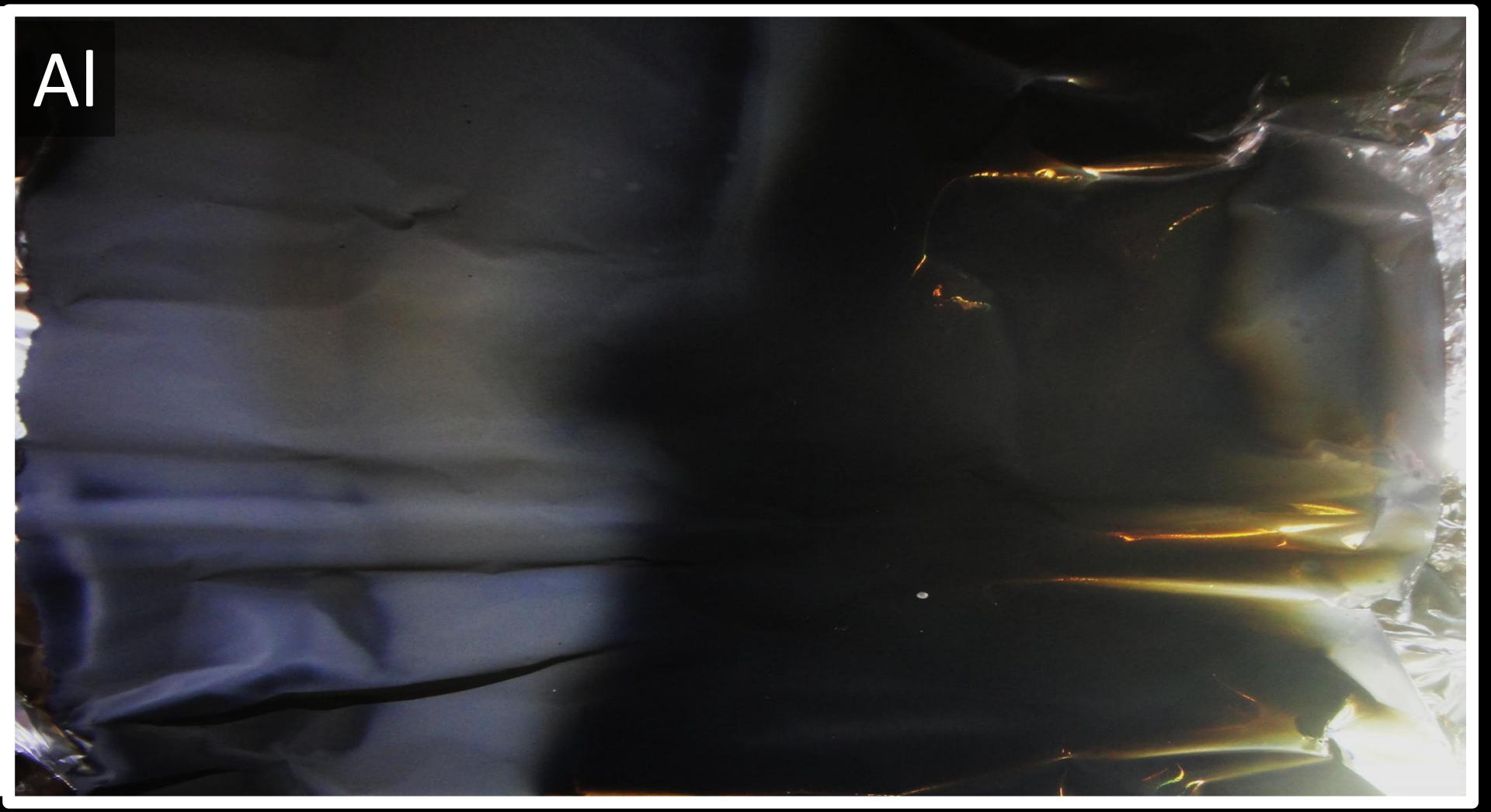
220 Amps!



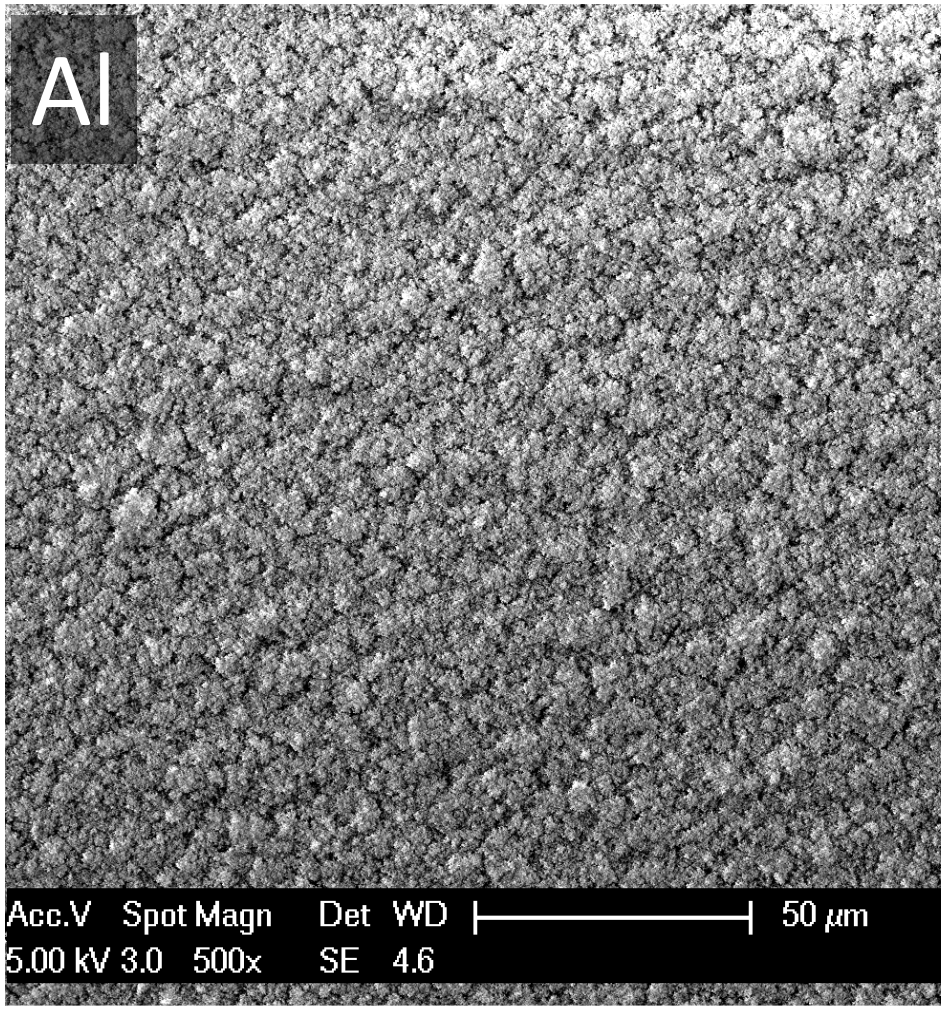
Do you hear something?

Gray Thin Film
1x

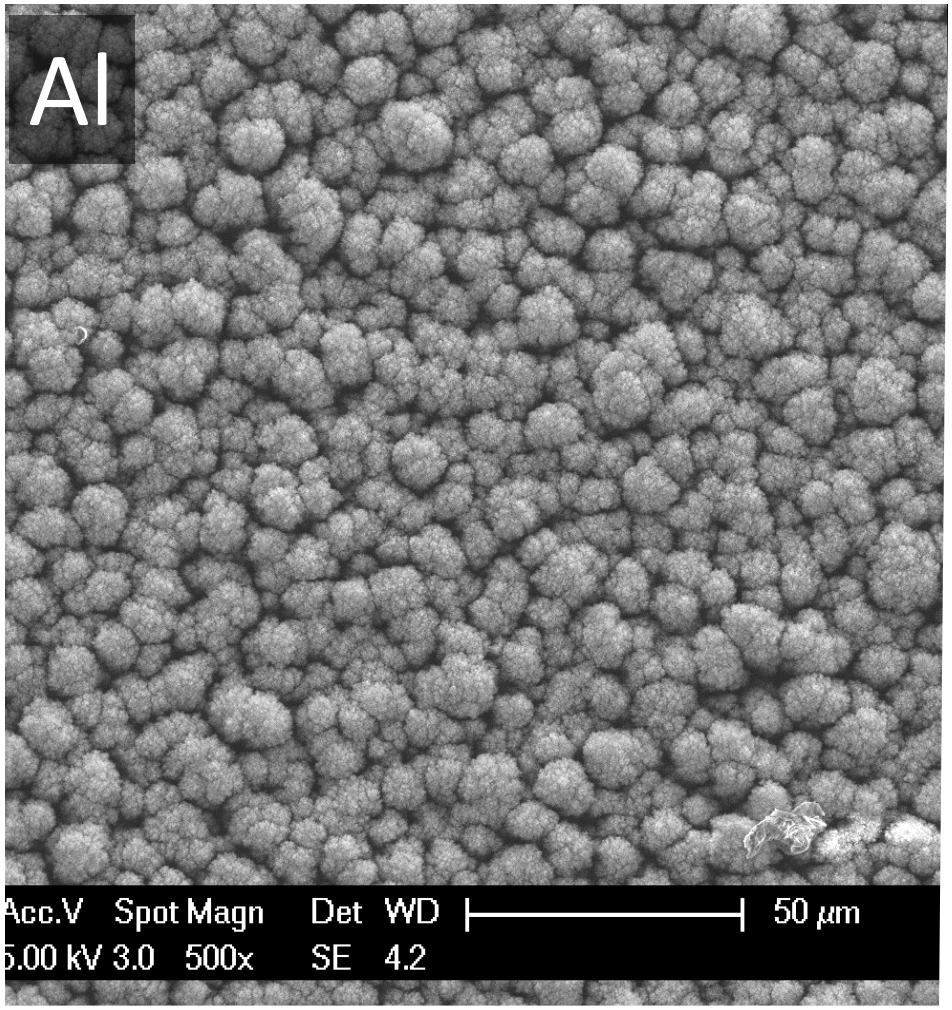
Black Thin Film
1x



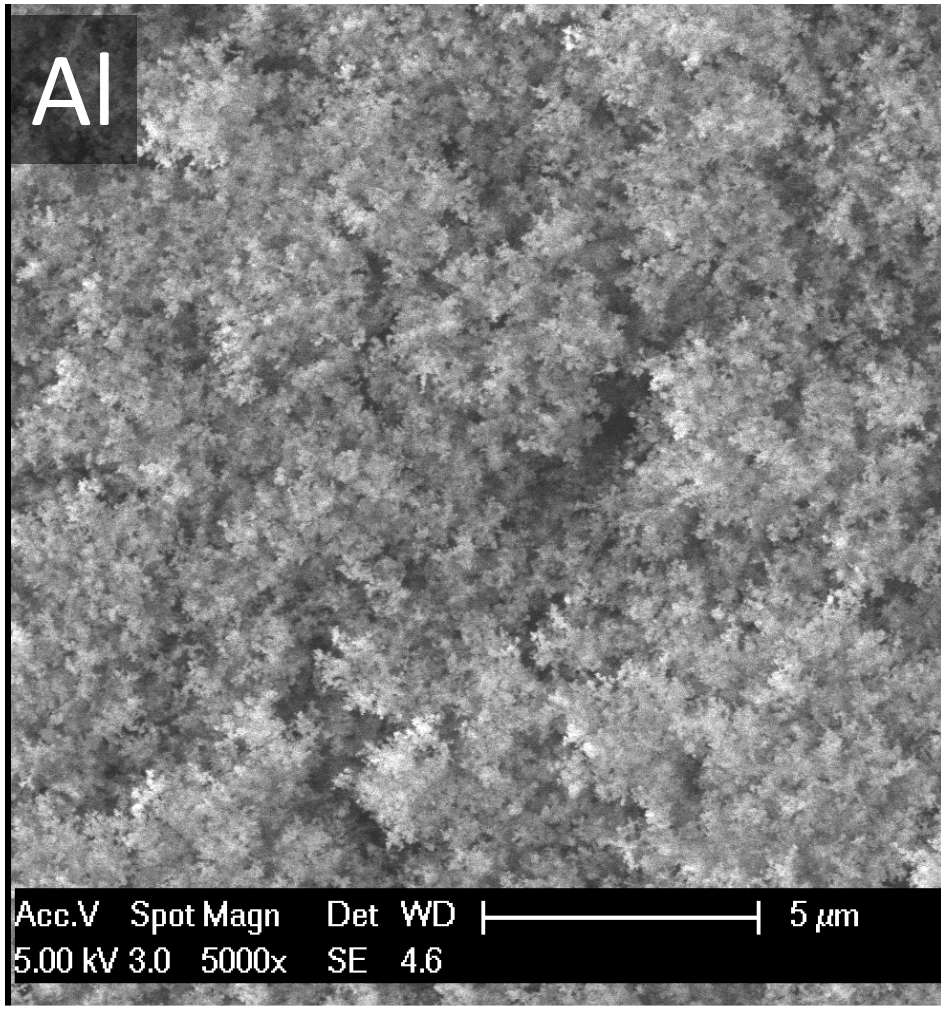
Gray Thin Film 500x



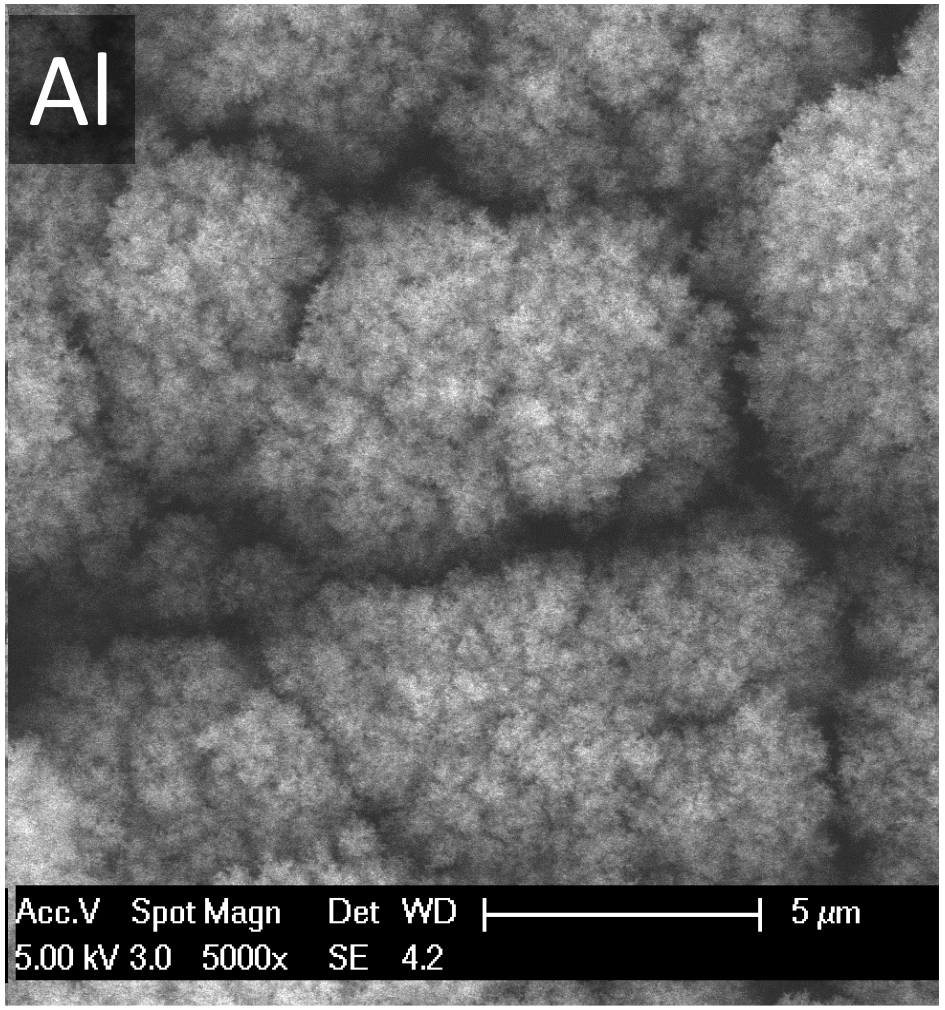
Black Thin Film 500x



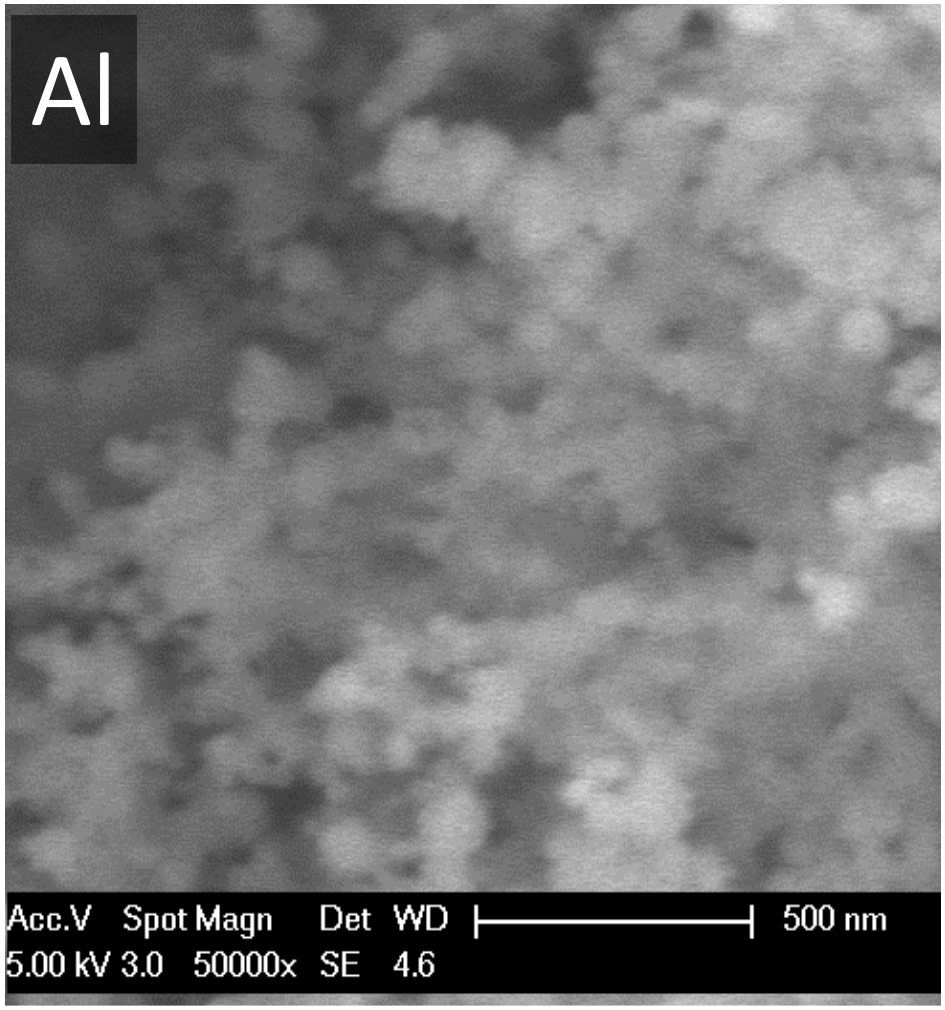
Gray Thin Film 5000x



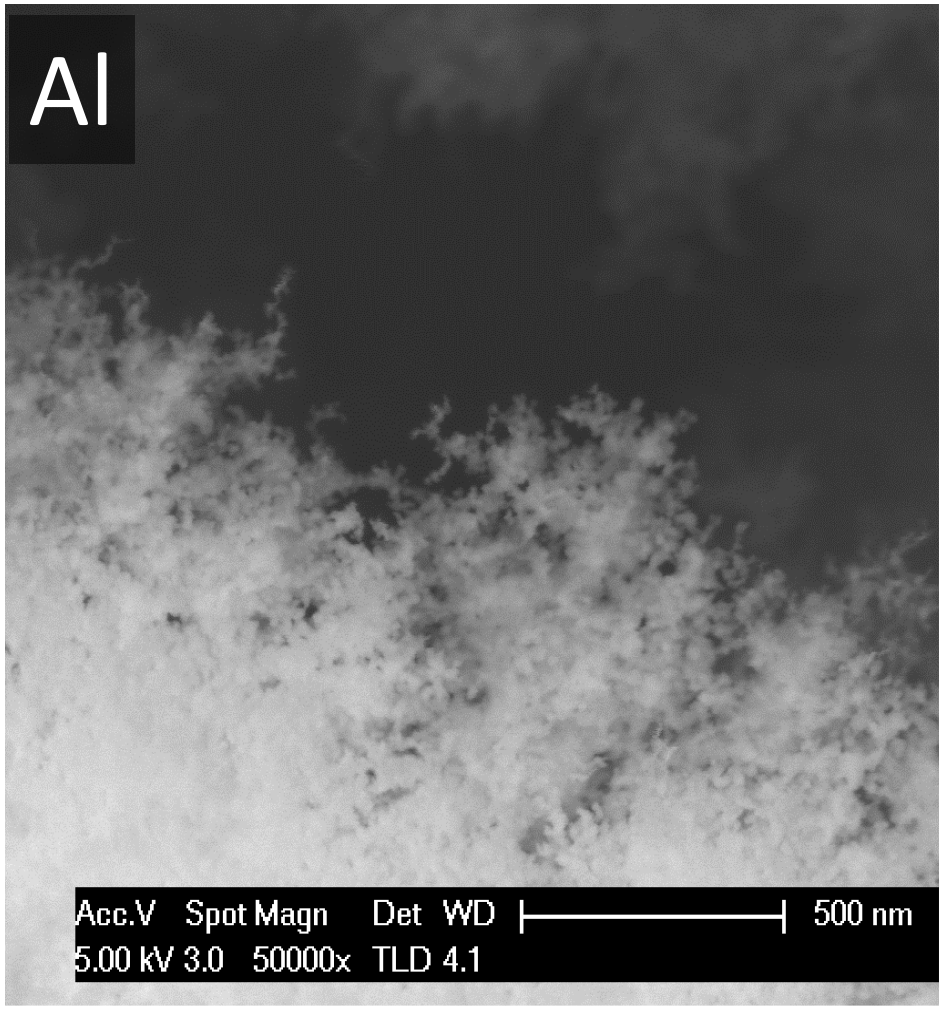
Black Thin Film 5000x



Gray Thin Film 50000x

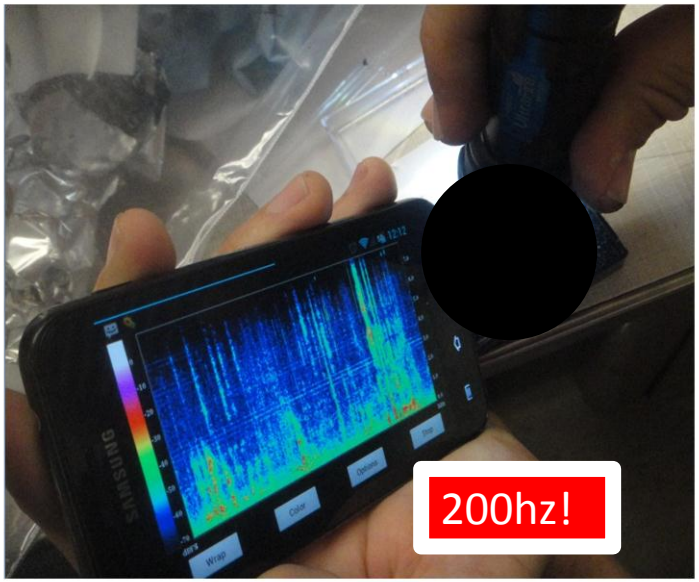


Black Thin Film 50000x



Resulting Properties

Photoacoustic Response
Films broadcast sound in response to intensity modulated light

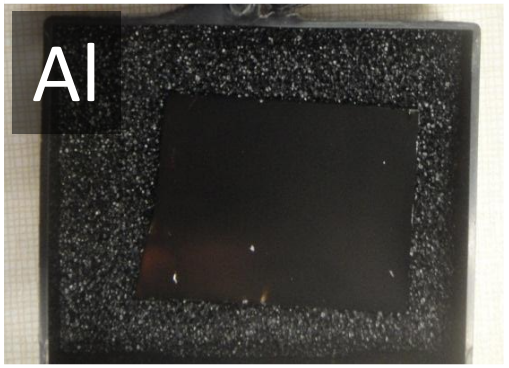


Vitreous Thin Film
.000001 Torr Argon Pressure

- No light absorption
- No photoacoustic response

Gray Thin Film
.1 Torr Argon Pressure

- Moderate light absorption
- Weak photoacoustic response



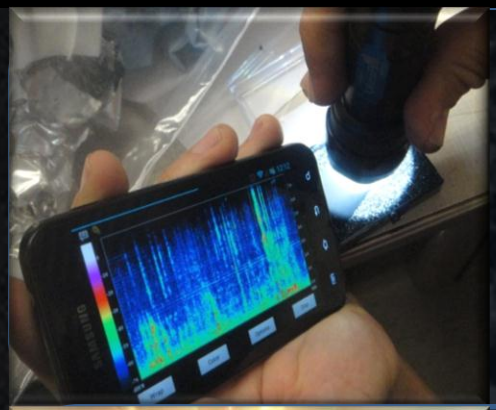
Black Thin Film
2.5 Torr Argon Pressure

- Very high light absorption
- Strong photoacoustic response

Summary Analysis

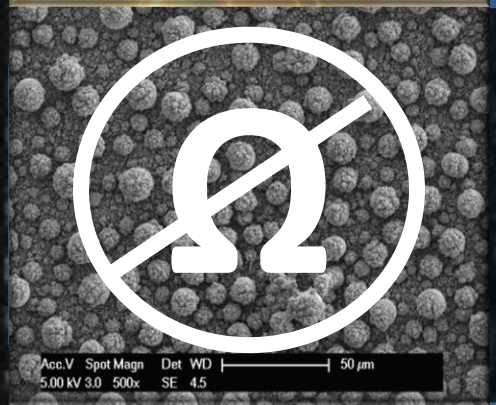
- Deposition parameters play a large role in determining structure
- Structure plays a large role in determining properties
- These novel properties may serve novel applications

Future Plans



- Photoacoustic effect:
  Measure the frequency range the films can broadcast

- High emissivity light sources:
  Determine the best geometry to allow for high emissivity thin films



- Disorder enhanced superconductivity:
  Explore the role nanostructure plays in superconductivity

Nanostructured Thin Metal Films

Acknowledgements

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Mentor

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Lab Partner

Machine Shop Instructor GUY

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