Tailored Oriented Thin Silver Films

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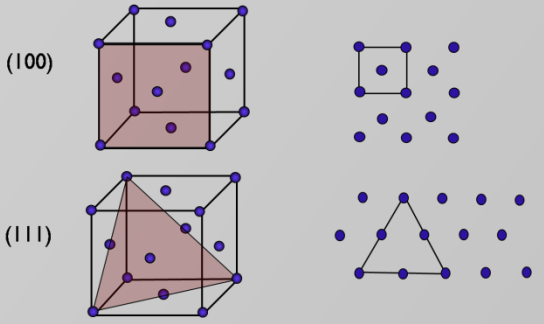
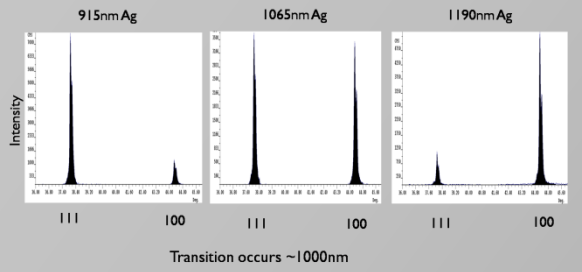
Outline

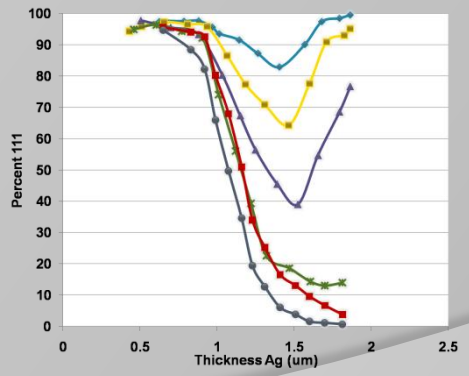
- 111 and 100 orientations



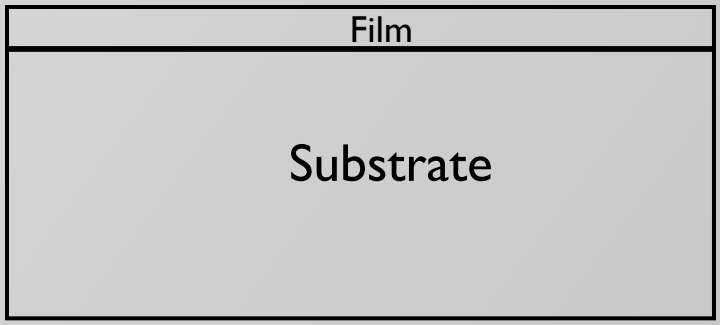
- Analysis by x-ray diffraction



- Effects of titanium and annealing

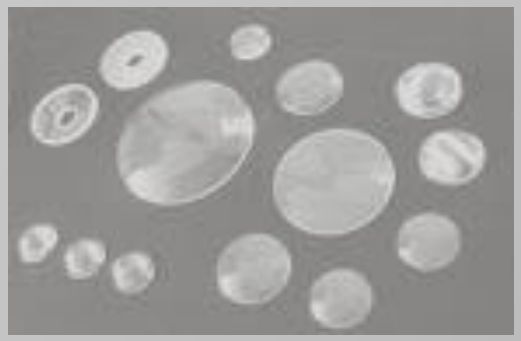


How thin is “thin”?



Nanometer to low Micrometer range

Why Silver?



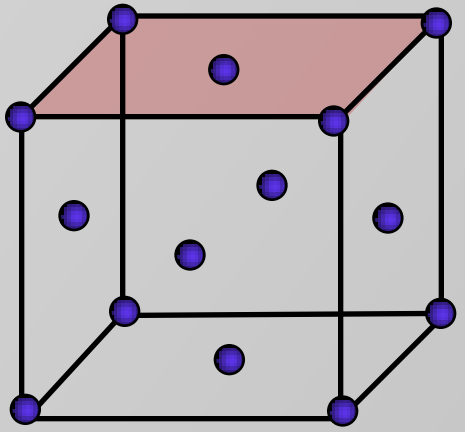
- Optimal Data Storage
- Highest Conductivity
- Superior Oxidation Resistance

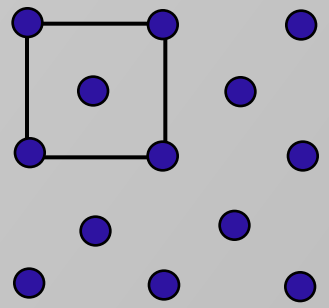
Images taken from: http://www.fotosearch.com/UNZ642/u15081405/ and http://www.diytrade.com/china/4/products/5075284/Optics_lens_stick_lens_then_the_cylindrical_lens_prisms_miniature_lens.html

Looking at Crystal Orientations

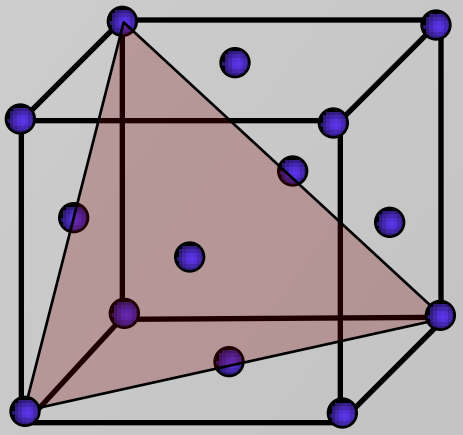
Face-Centered Cubic

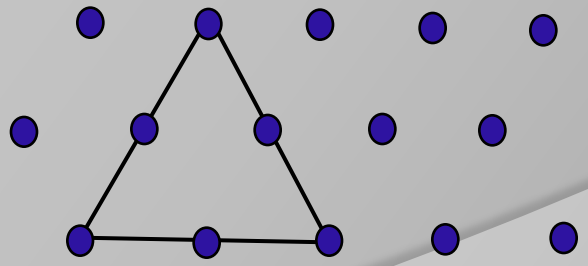
(100)



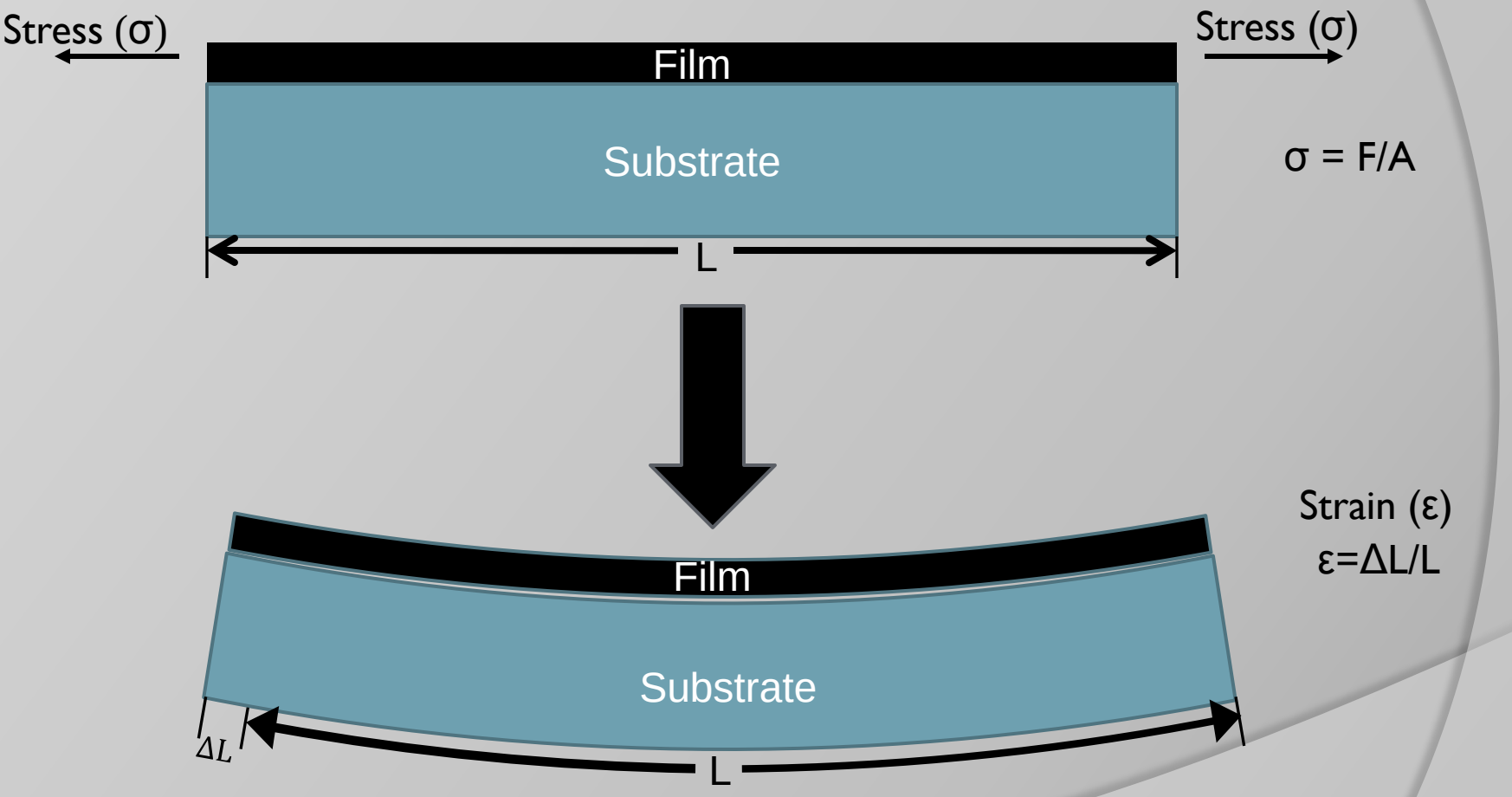


(111)

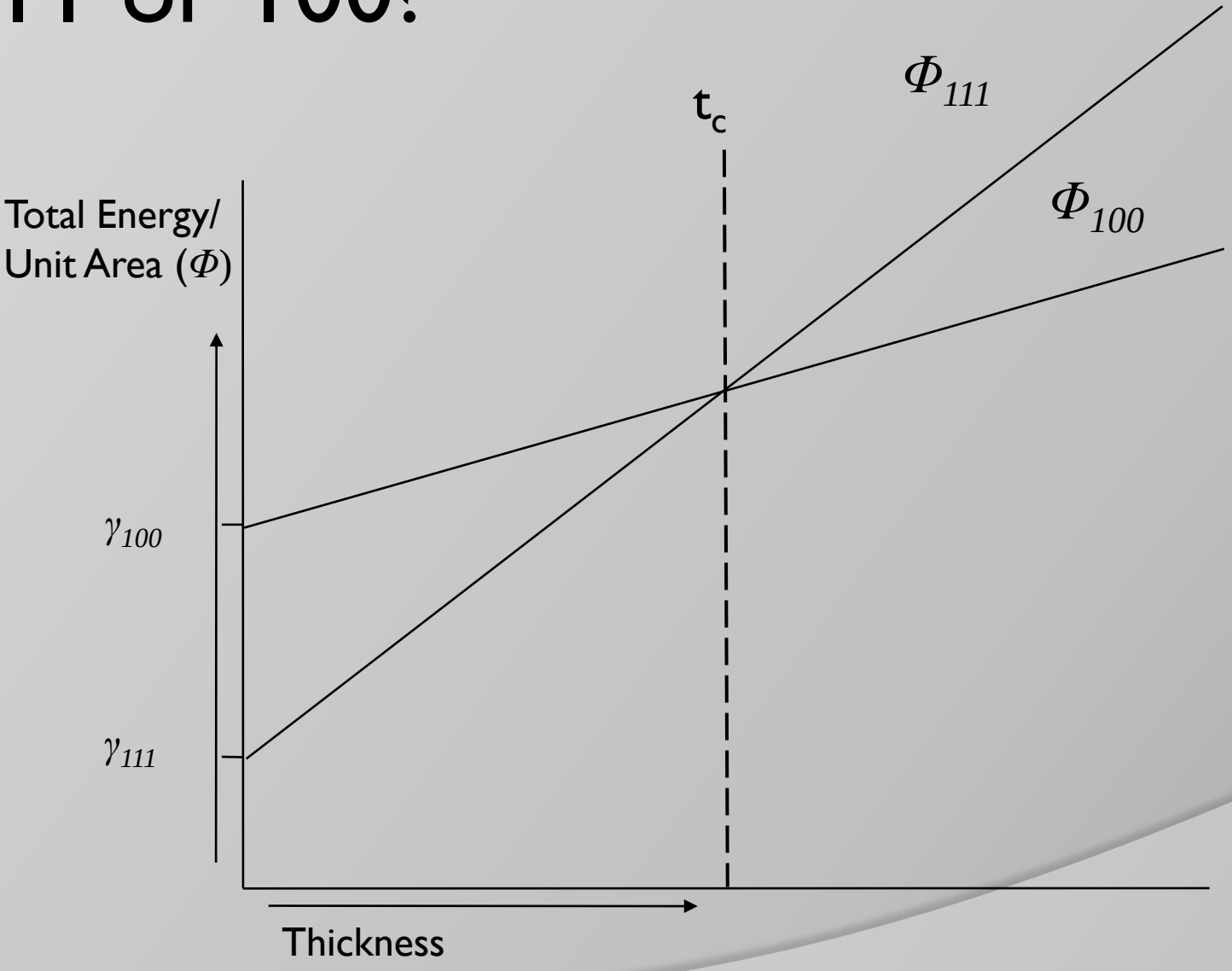




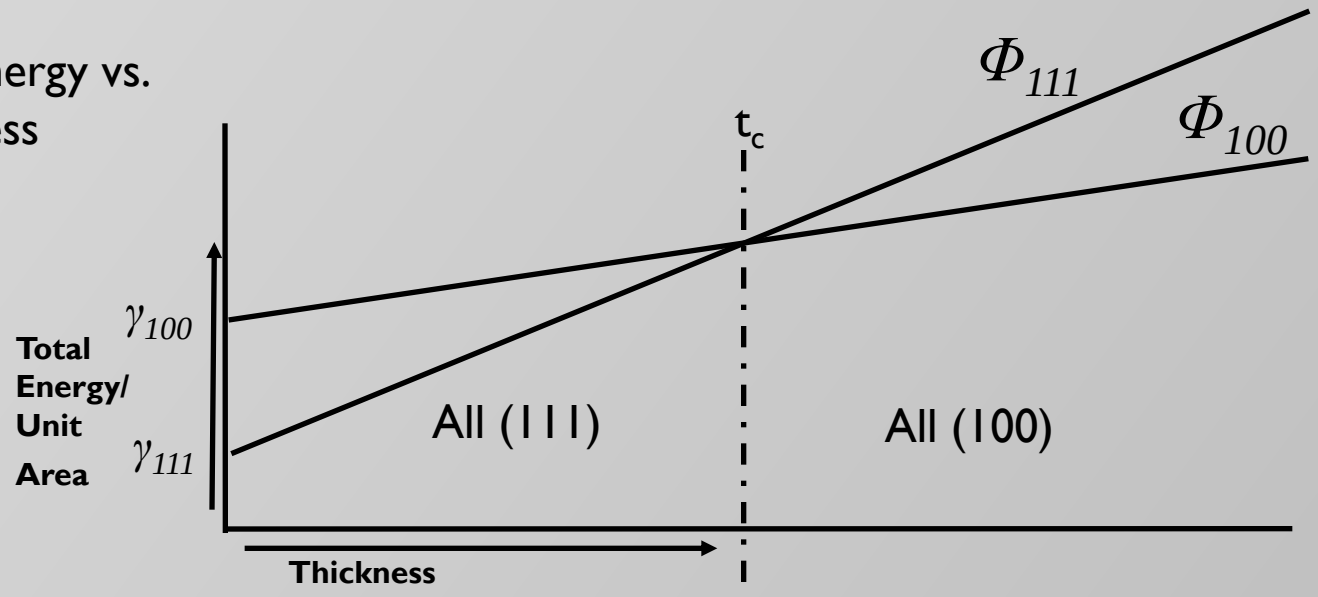
Film Stresses – Thermal Strains



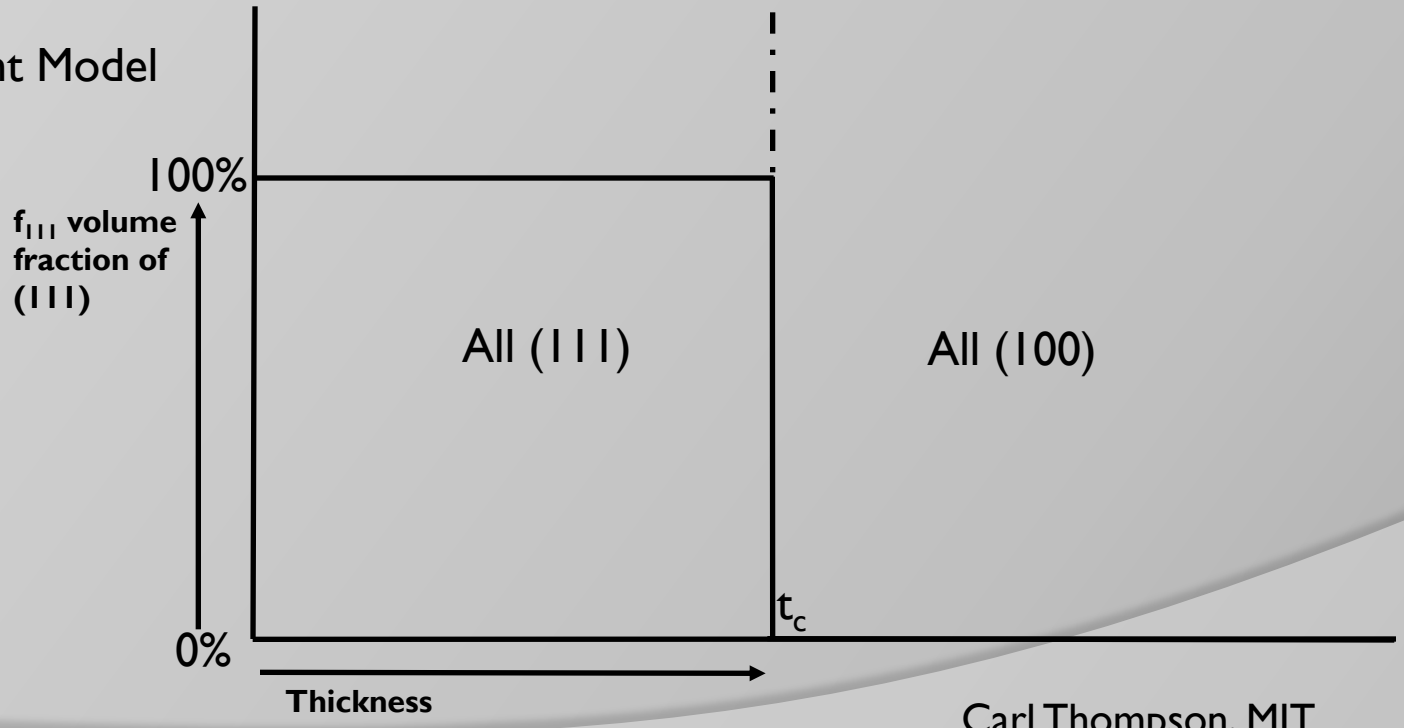
111 or 100?


t_c
Φ_{111}
Φ_{100}
Total Energy/
Unit Area (Φ)
γ_{100}
γ_{111}
Thickness

Total Energy vs. Thickness

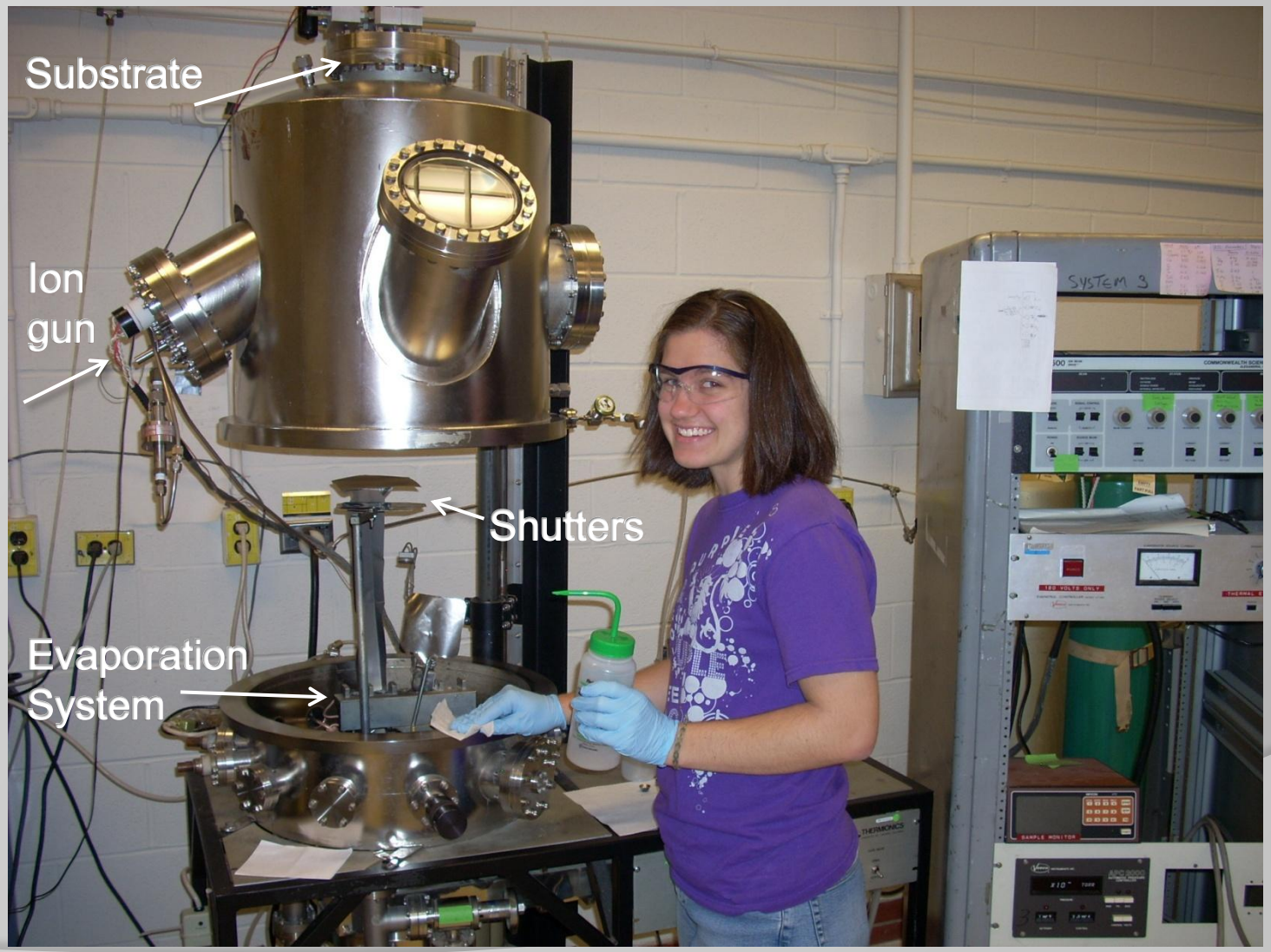


Current Model

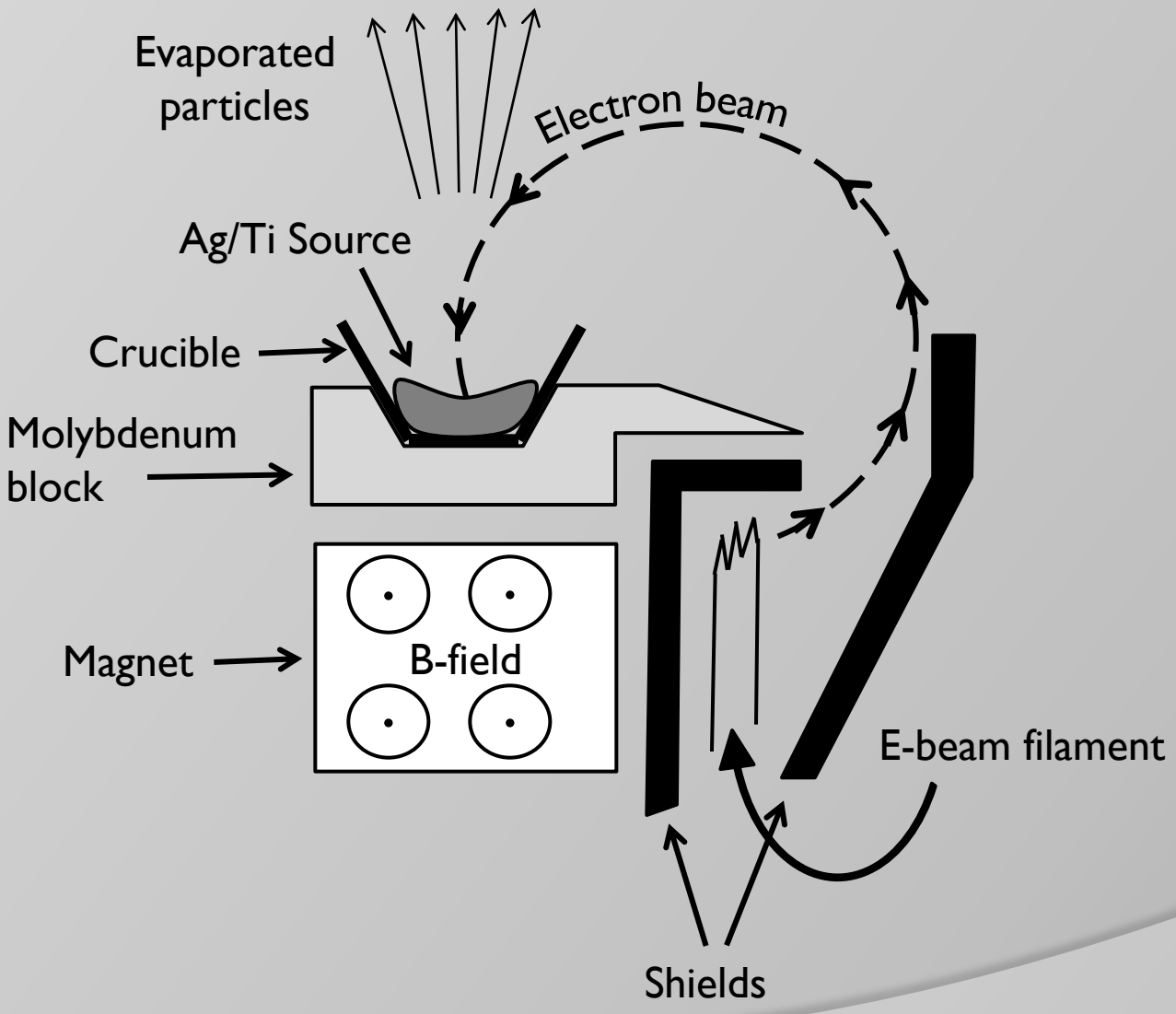


Carl Thompson, MIT

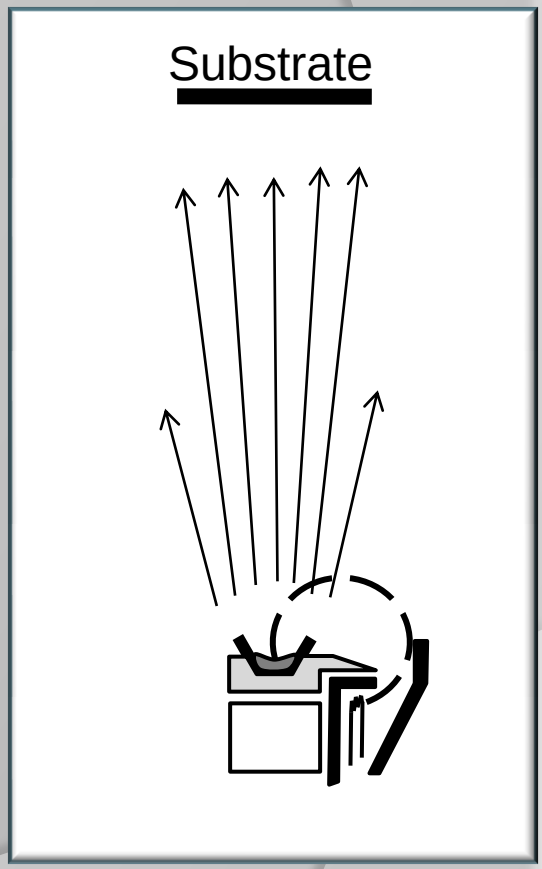
Deposition Chamber



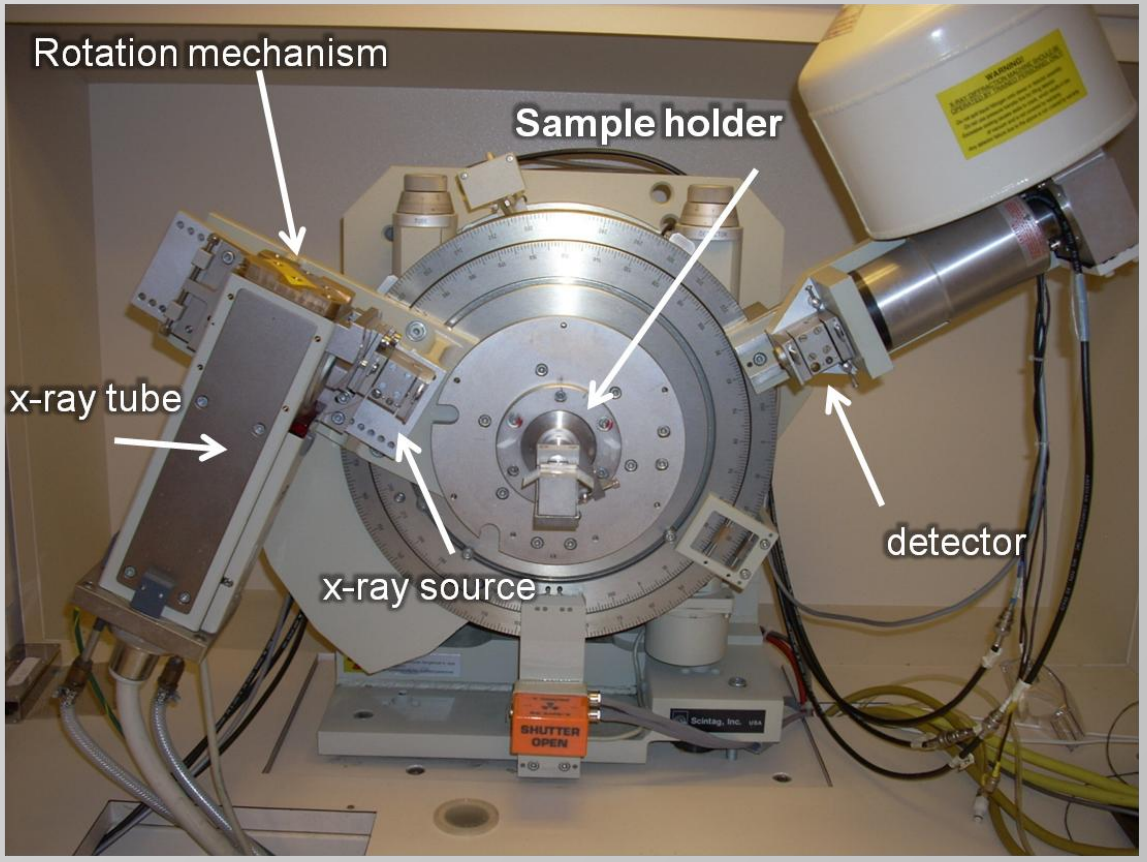
E-beam system



~3x10^{-6} torr



Film Analysis



$$n\lambda = 2d \cdot \sin\theta$$

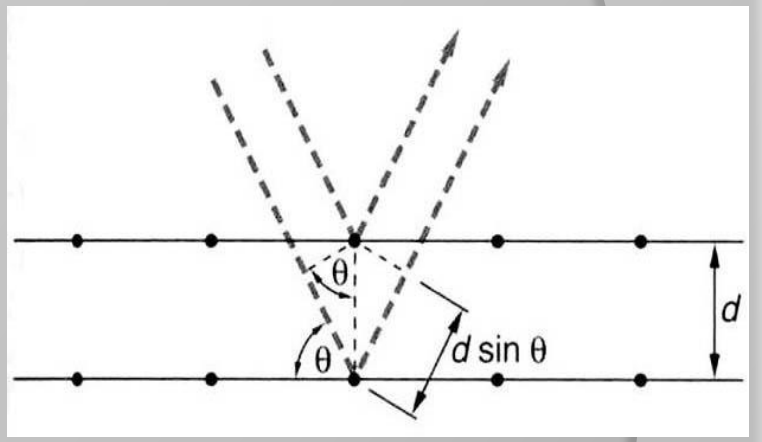
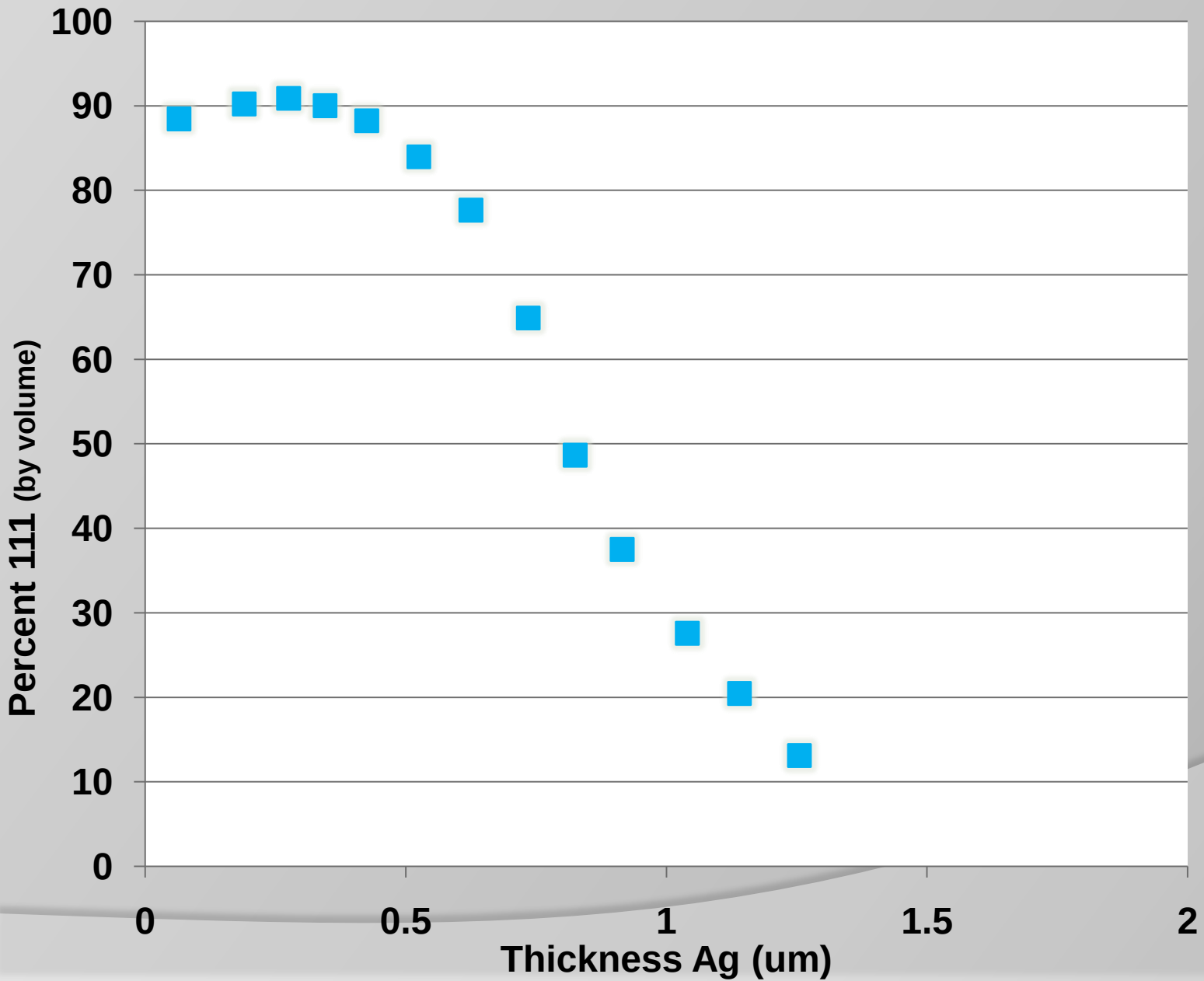
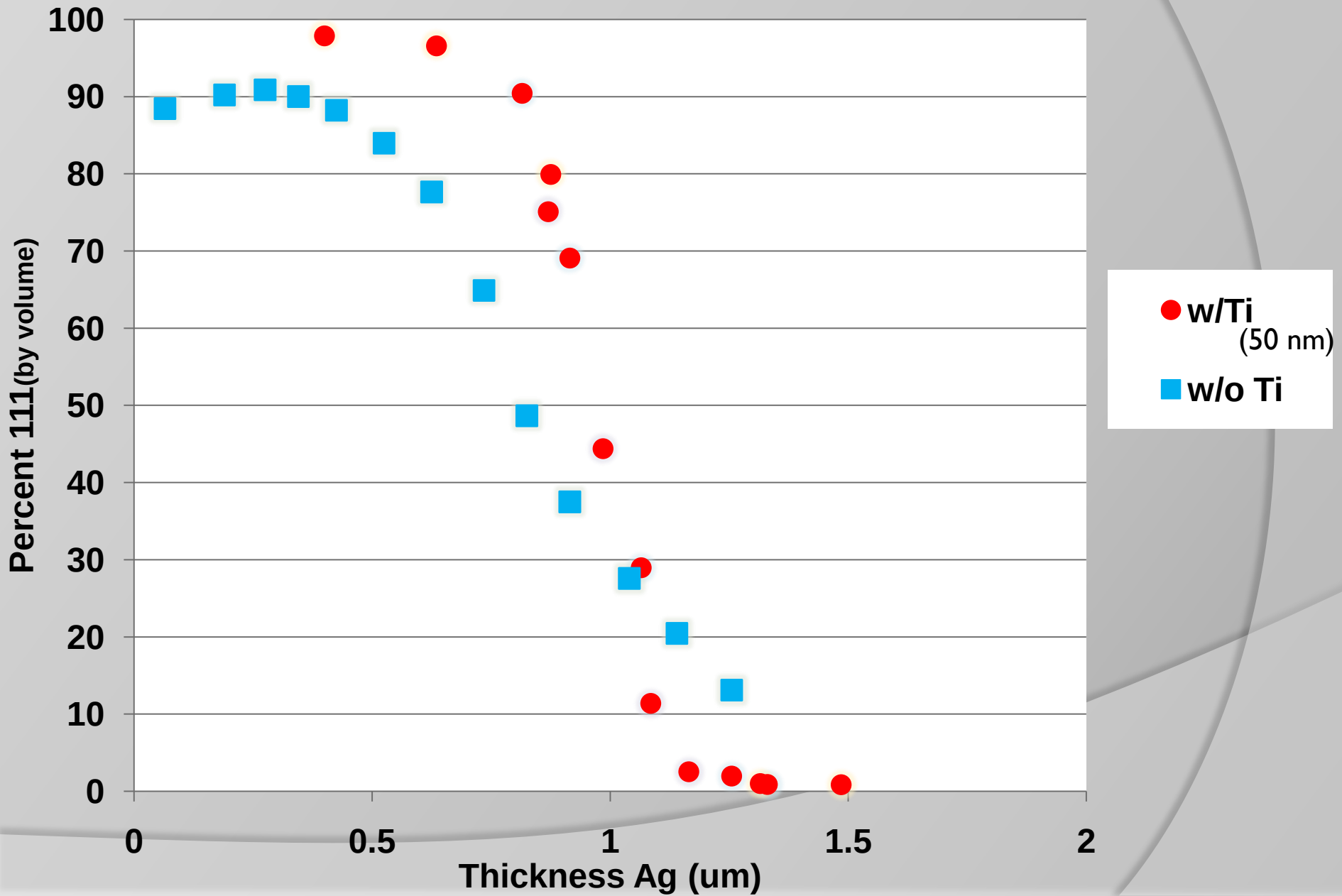


Image taken from:
http://www.farmfak.uu.se/farm/farmfyskem-web/instrumentation/images/Braggs%20law.jpg

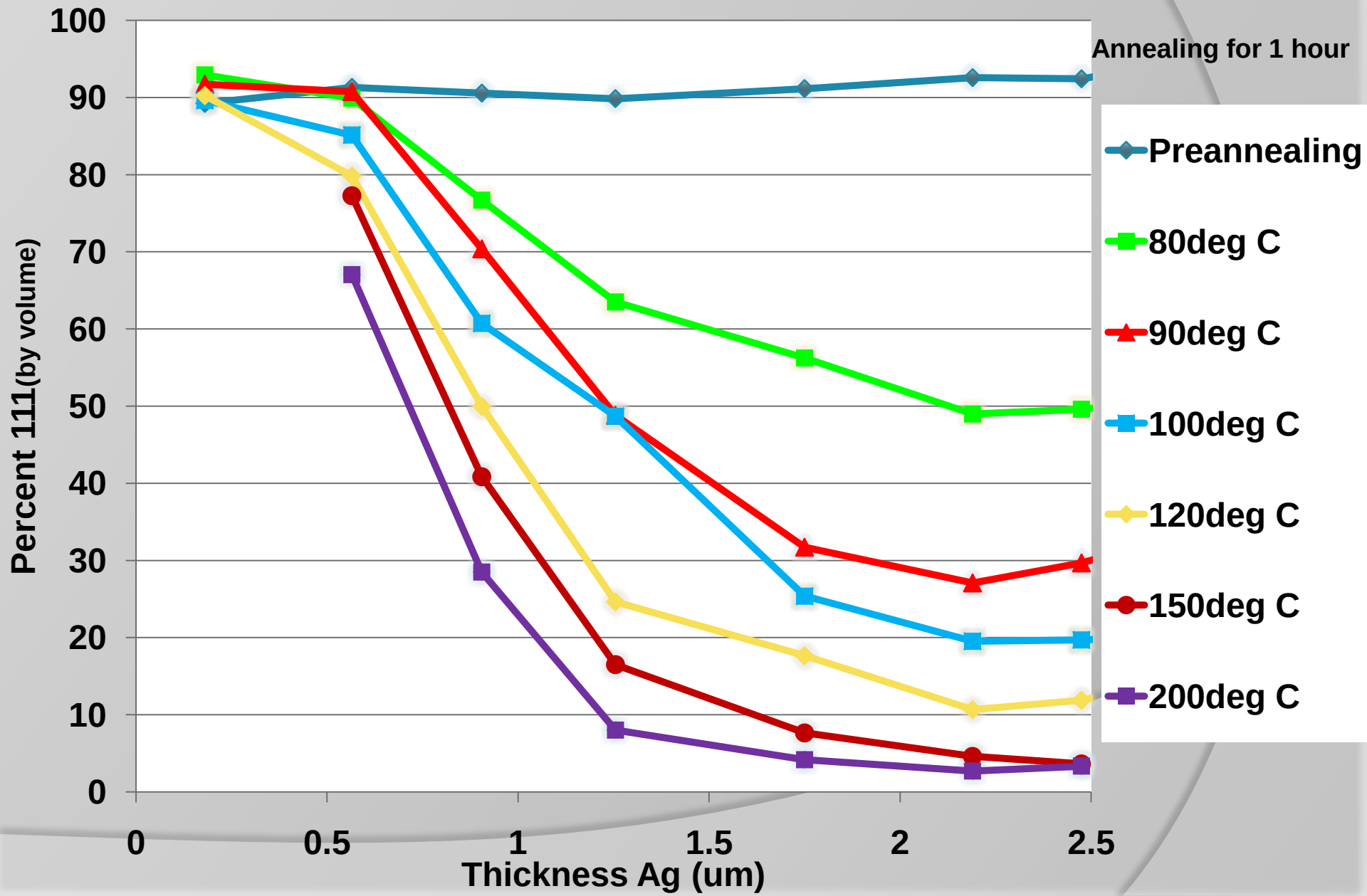
Experimental Results for Silver



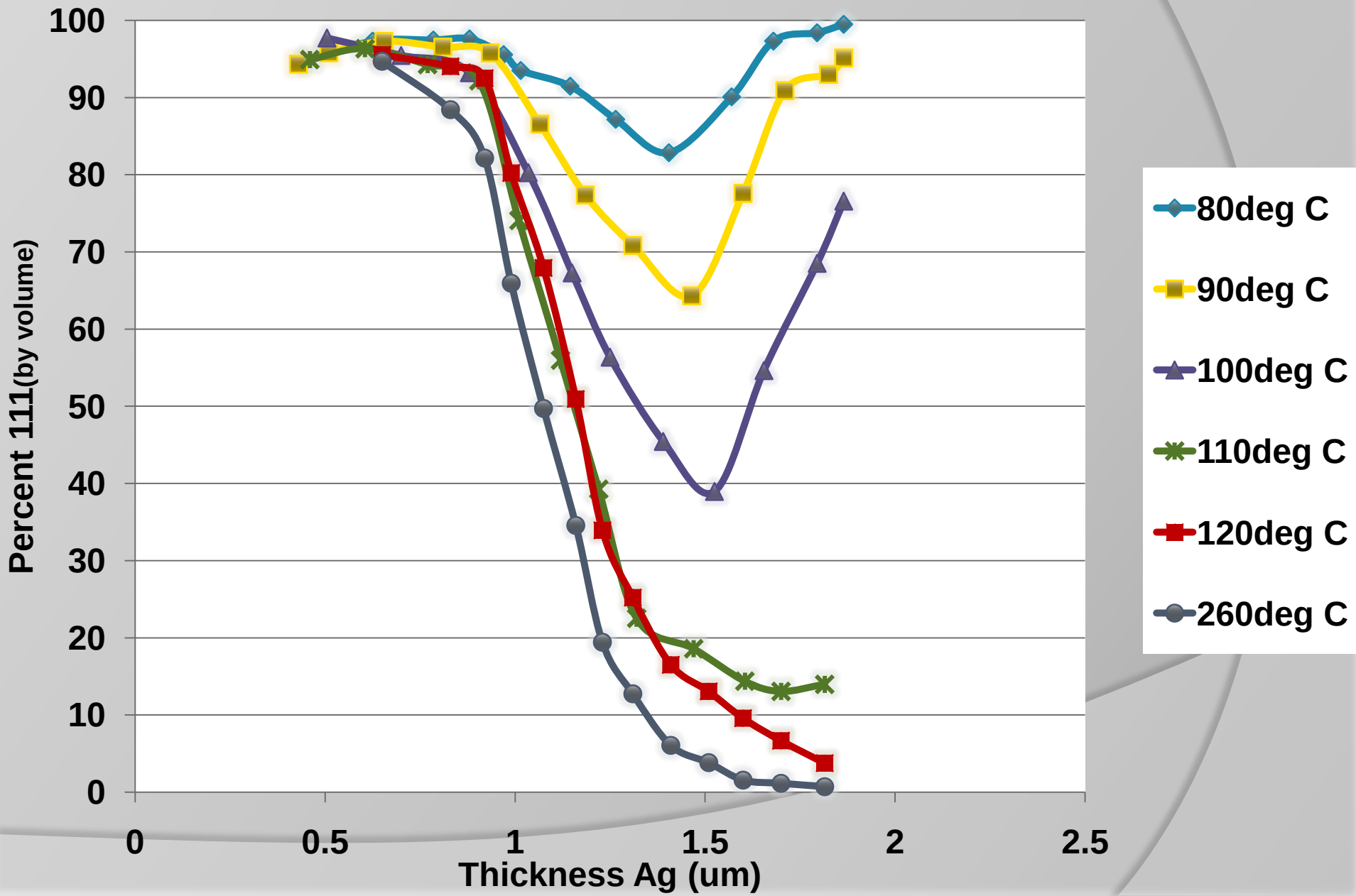
How Titanium Affects the Transition



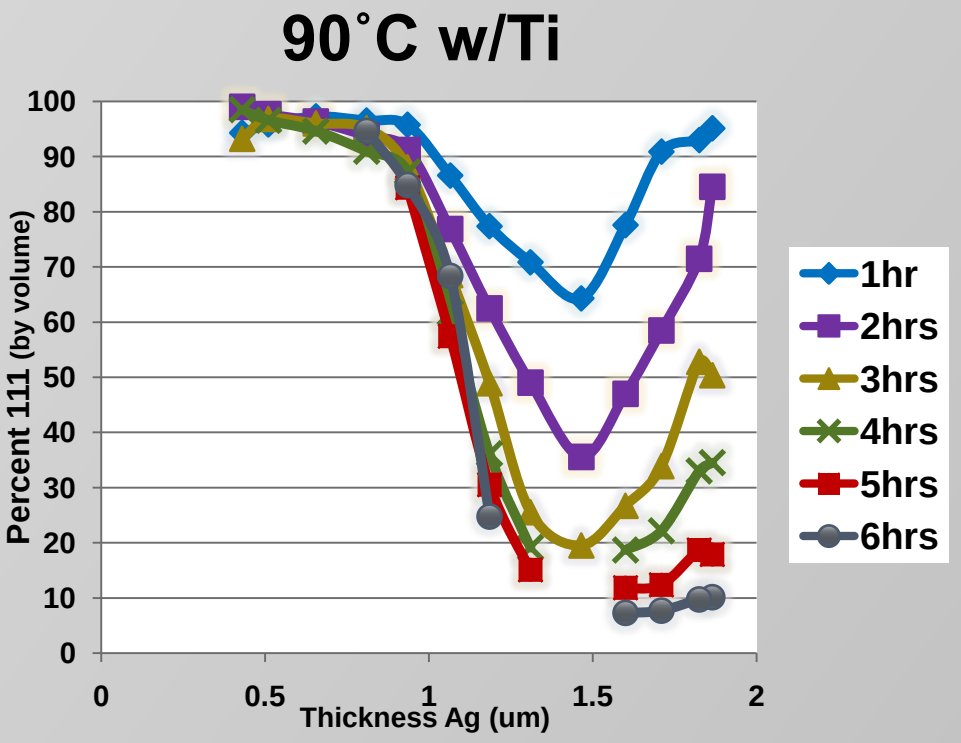
How Temperature affects the transition

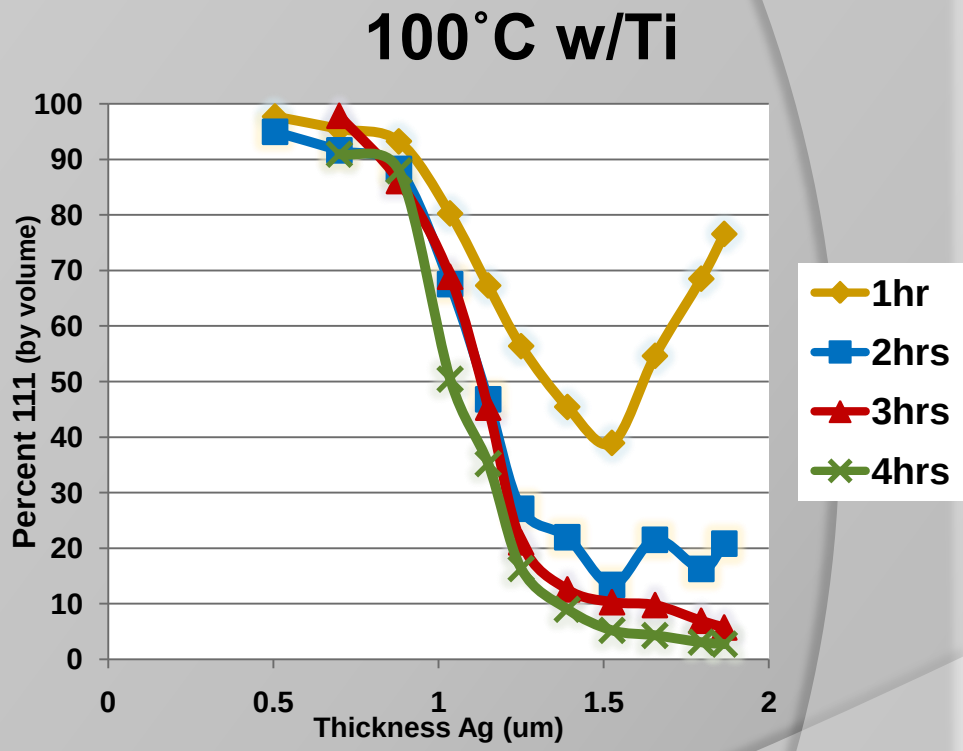


Effects of Temperature with Titanium



Varying Annealing Time with constant Temperature





Transition fully occurs after extended annealing

Conclusions

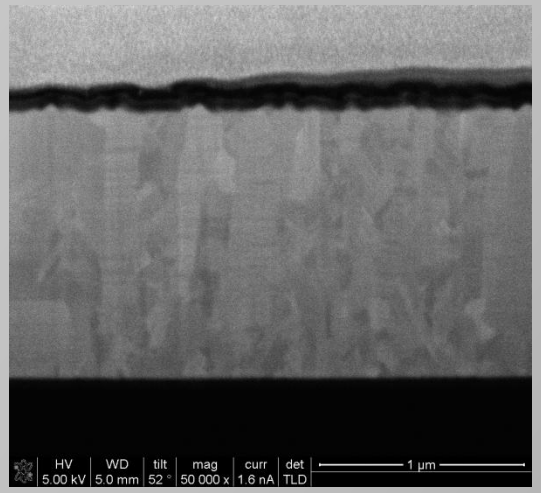
-Titanium sharpens orientation transition

-Effects of annealing temperature and time were measured

-Further studies

- Explore imaging of silver grains

- Verify results with other samples



Thank you to:

- Adam Silvernail, Brandon Hoffman and Shefford Baker

-The National Science Foundation

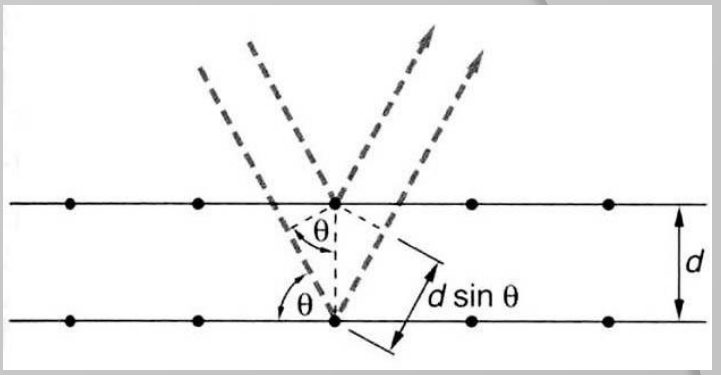
- SRI at Houghton College

- CCMR REU at Cornell University

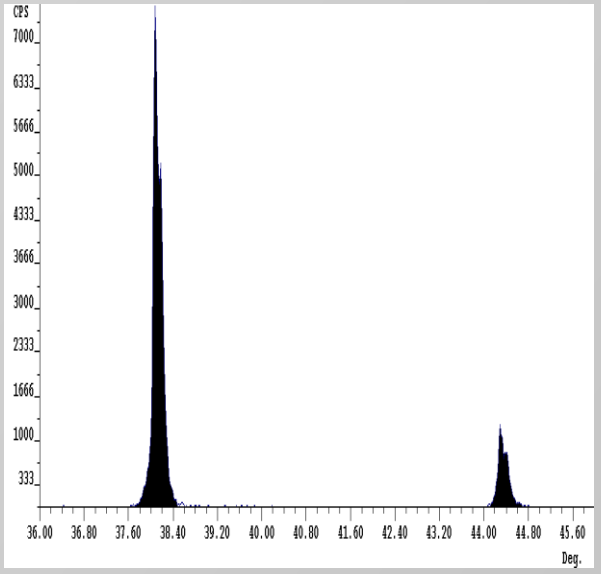
X-ray Analysis

Bragg's Law

$$n\lambda = 2d \cdot \sin(\theta)$$

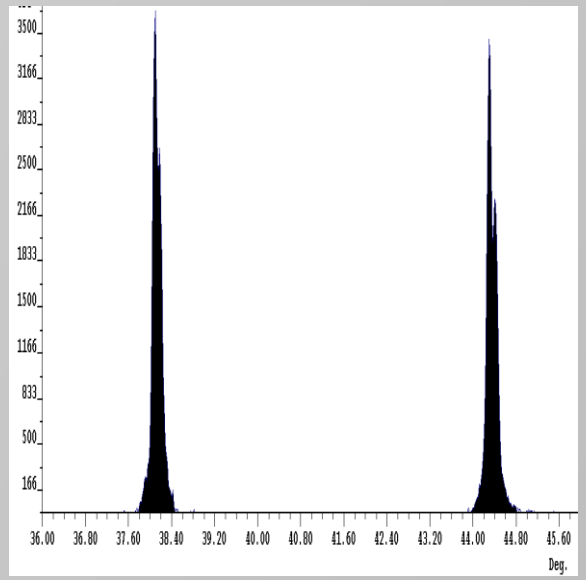


915nm Ag



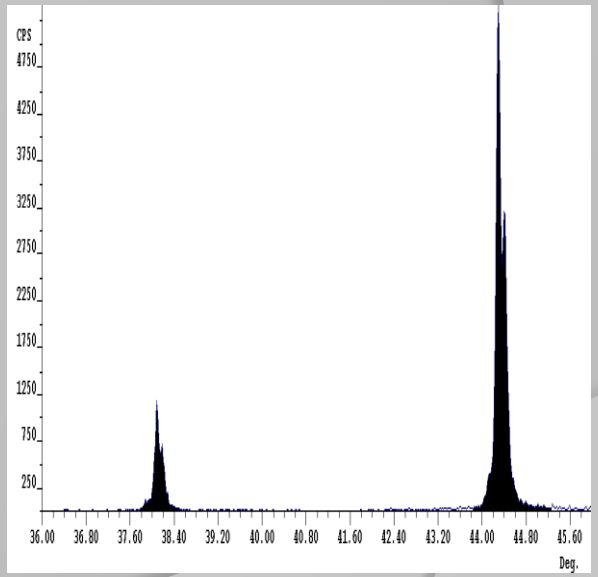
111 100

1065nm Ag



111 100

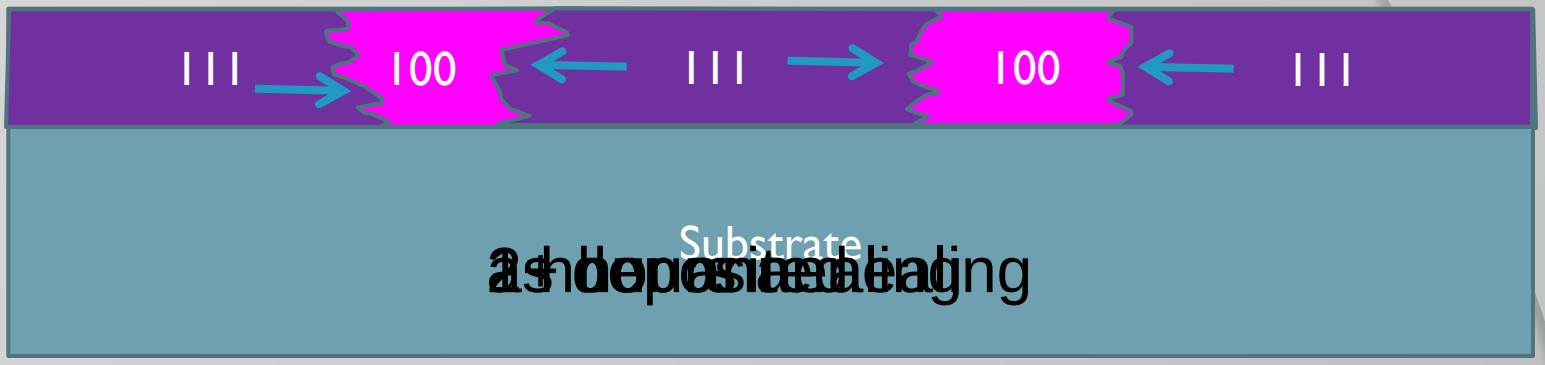
1190nm Ag



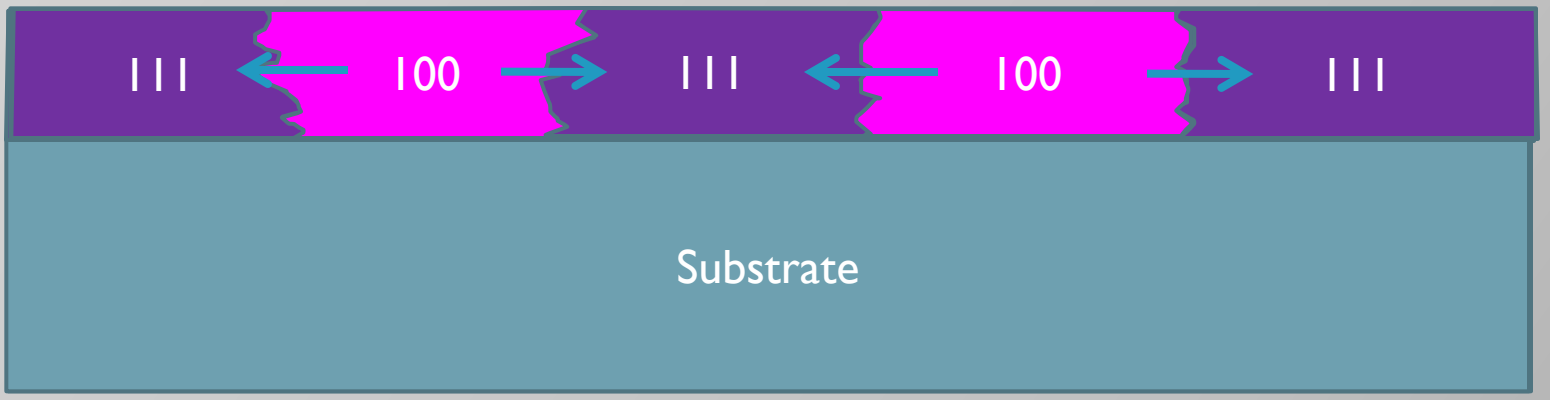
111 100

Intensity

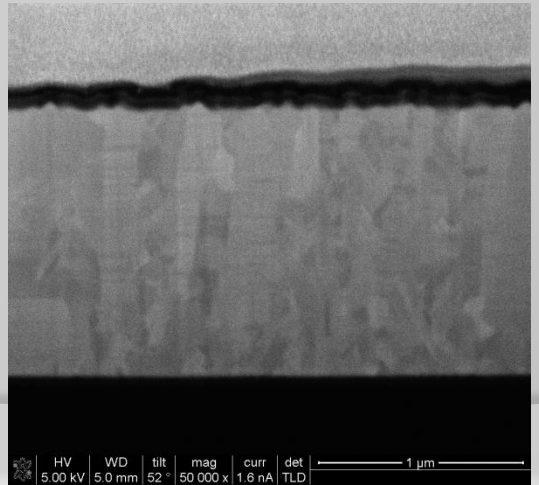
Transition occurs ~1000nm



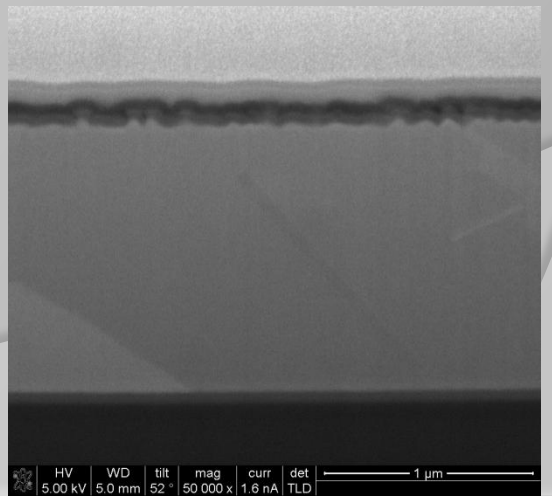
Thin Silver



Thick Silver



After annealing



Sample Preparation