

# **Atomic Layer Deposition at ASU NanoFab**

S. Myhajlenko and A. Handugan  
Arizona State University

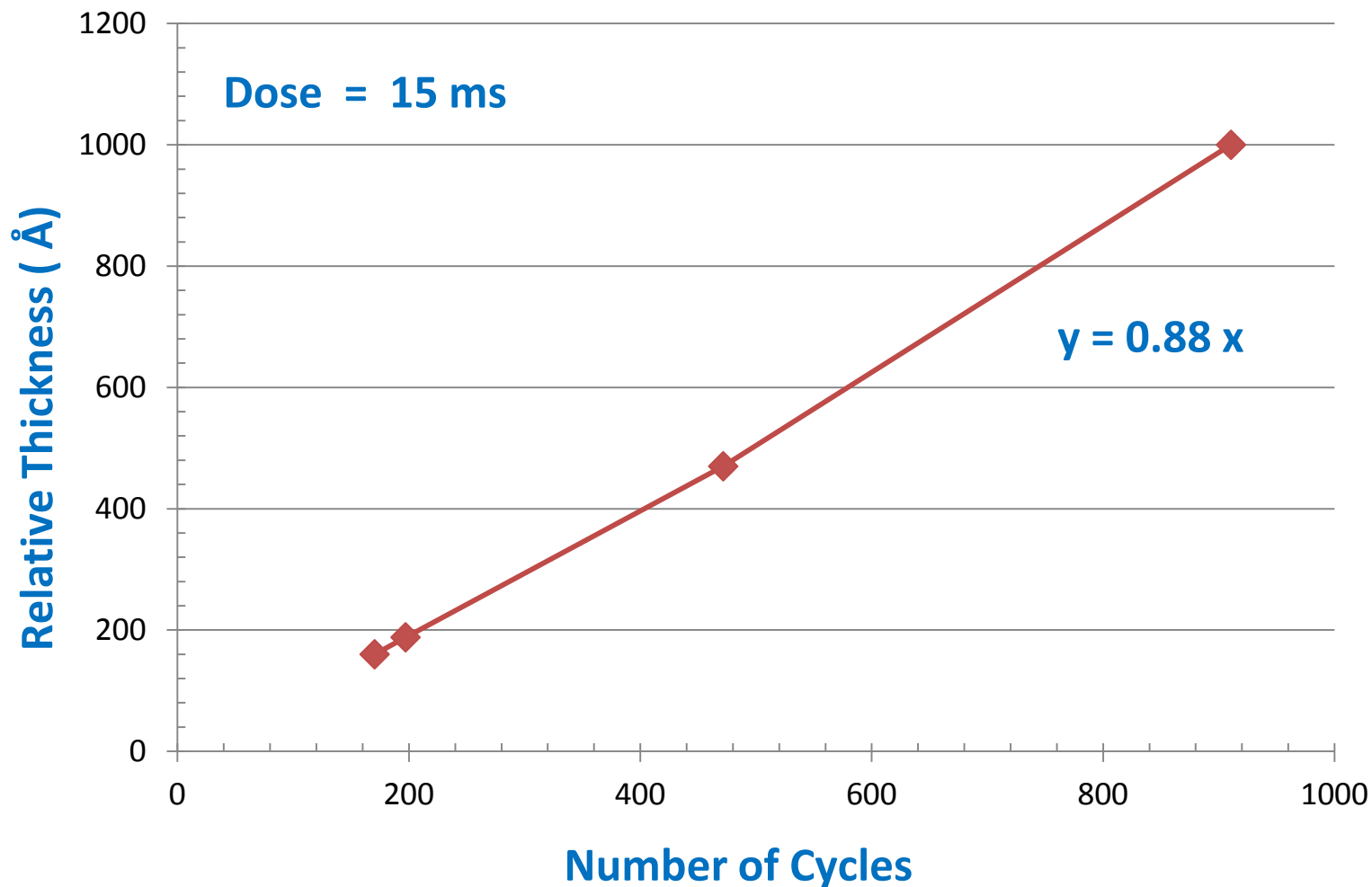
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# Current ALD Capability

- Cambridge Nanotech Savannah – one unit
- Available chemical precursors –
  - Trimethyl Aluminum ( $\text{Al}_2\text{O}_3$ )
  - Diethylene Zinc ( $\text{ZnO}_2$ )
  - Tetrakis (dimethylamino) Hafnium ( $\text{HfO}_2$ )
- First film ( $\text{Al}_2\text{O}_3$ ) deposited on 9/27/2012  
c/o J Provine & M. Rincon (Stanford)
  - Growth rate  $0.88 \text{ \AA}/\text{cycle}$  (15 ms dose)
- $\text{HfO}_2$  deposition – (10 ms dose)
  - Growth rate  $0.95 \text{ \AA}/\text{cycle}$



# Al<sub>2</sub>O<sub>3</sub> Growth Rate



# Equipment Issues

- TDMA- Hf pre-cursor needs heater jacket at 75 °C
  - Always have to enter this set point thru GUI otherwise heater doesn't come on
- We have APS UPS and every time we login we get the following dialog box
  - “Do you want to allow the following program to make changes to this computer?”
- After launching the tool software, we frequently get the following error
  - USB ERROR/From Command: MPUSBWrite/Called from Savannah.vi
  - Power cycling the circuit breakers on the front of the tool rectifies this error?
- One run aborted during a Windows update
  - Is this common?
- Over pressure abort (> 1 Torr) when we first ran HfO<sub>2</sub>
  - Reducing the dose from 15 ms to 10 ms fixed the problem
  - But this value is faster than the valve can operate?
- Cambridge Nanotech support
  - No response to email sent 11/19/2012 and web site access denied.....
- Equipment Usage Level
  - very low % since we're still evaluating the tool

# Future Plans

- Film characterization – thickness is relative since based on pre-existing optical models loaded in Woollam ellipsometer
  - Refractive index (need to determine independently)
- Thin  $\text{Al}_2\text{O}_3$  hard mask for nanolithography application
  - Preliminary RIE (Cl/Ar) sputter etch data of 20 nm/min vs. 120 nm/min for PMMA is promising.
- Looking to add  $\text{TiO}_2$  capability in the near future
- Proposal has been submitted for  $\text{GdO}_2$ ,  $\text{Ta}_2\text{O}_5$ , and  $\text{WO}_3$ 
  - Application as dielectric stack for programmable memory cells