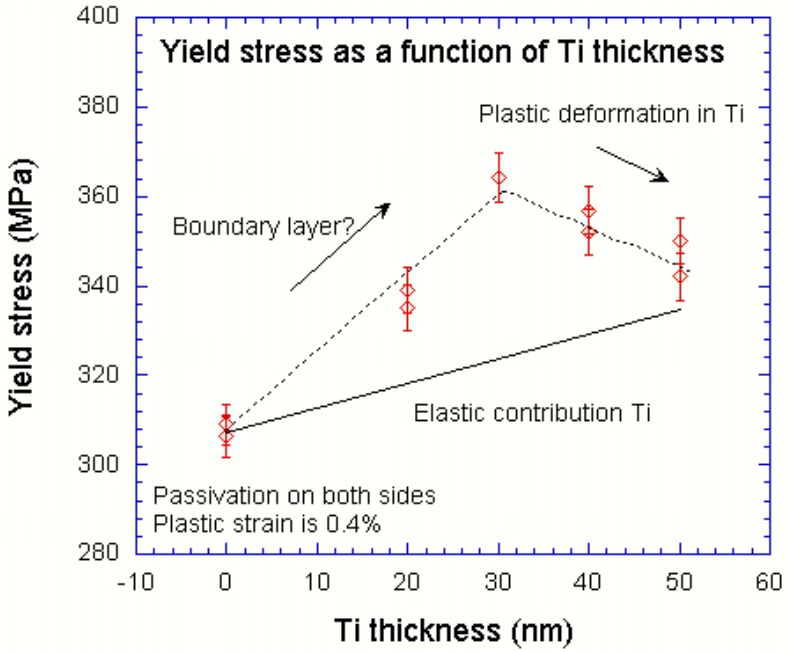
Study of the Mechanical Behavior of Metal Thin Films and Shape Memory Alloy Coatings

Joost Vlassak, Harvard University, DMR-0133559

The mechanical behavior of thin metal films is governed by the fine length scales of their microstructure. The figure illustrates the effect of a very thin passivating film on the flow stress of a freestanding electroplated Cu film. Growing a 30 nm Ti film increases the yield stress significantly. This has been attributed to the formation of a boundary layer with increased dislocation density (Nicola et al., 2003). These results shed light on basic aspects of plasticity and find application in the semiconductor industry where they are used to model stresses in Cu interconnects.



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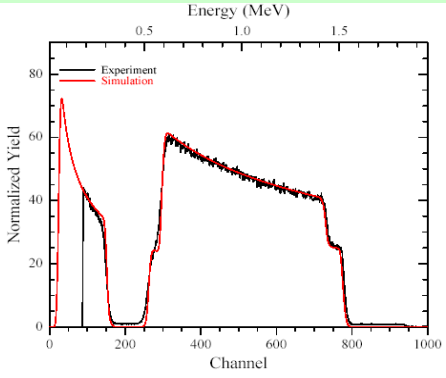
Training

Three graduate and two undergraduate students contribute to this work:

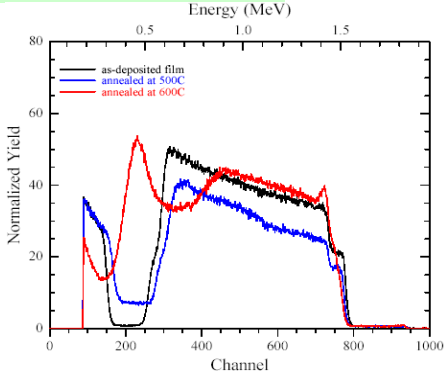
- One graduate student is working on elemental metal films (Yong Xiang), one graduate student is investigating NiTi shape memory coatings (Xi Wang), and one student (Patric McCluskey) is investigating ferromagnetic shape memory alloy coatings.
- One undergraduate (Roy Kaiser) designed and built a novel apparatus for mapping film stress, one undergraduate (Ann Lai) is optimizing deposition conditions for NiTi shape memory coatings.

Undergraduate Roy Kaiser built a new-laser based stress measurement device for his senior project

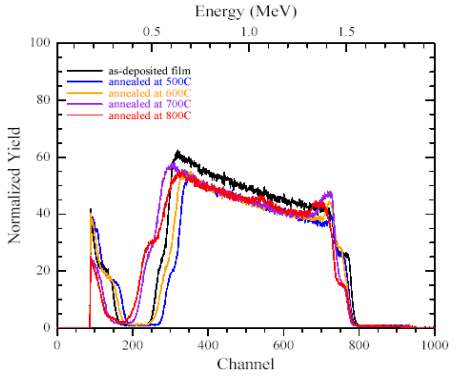
RBS spectra illustrating interaction between film and substrate (Ann Lai).



(a) As deposited NiTi on Si



(b) Annealed NiTi on Si



(c) Annealed NiTi on SiN_x