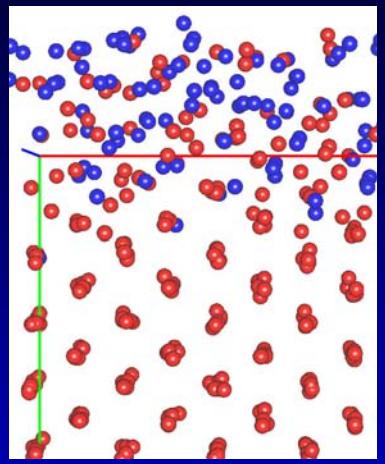
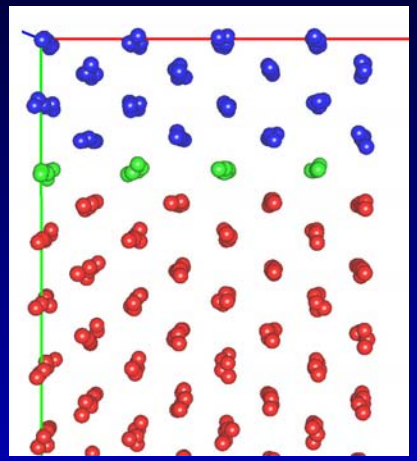
Controlling Interface Structure using Metallic Interlayers

Richard J. Smith, Montana State University, NSF-DMR 0077534

- Construction of metal, thin-film devices often requires stable metal-metal interfaces, limited interdiffusion, and a template for subsequent growth. The goal of this project is to use a metallic interlayer (e.g. Ti) to promote ordered film growth at an interface otherwise characterized by interdiffusion and disorder (e.g. Fe/Al).

- Monte Carlo simulations (near right) for Ni on Al(100) show a disordered alloy typical of many transition metal-aluminum interfaces. The ideal structure (far right) might offer improved performance or even new physical properties.





- Using MeV ion channeling and backscattering, disorder at the Fe-Al interface with no interlayer leads to increased visibility of Al atoms as shown by an increase in scattering yield (upper curve). With 1or 2 Ti layers at the interface, scattering from substrate Al atoms decreases (lower curves) as Fe atoms in an ordered overlayer shadow the Al atoms! The structure is stable to ~ 250 °C.

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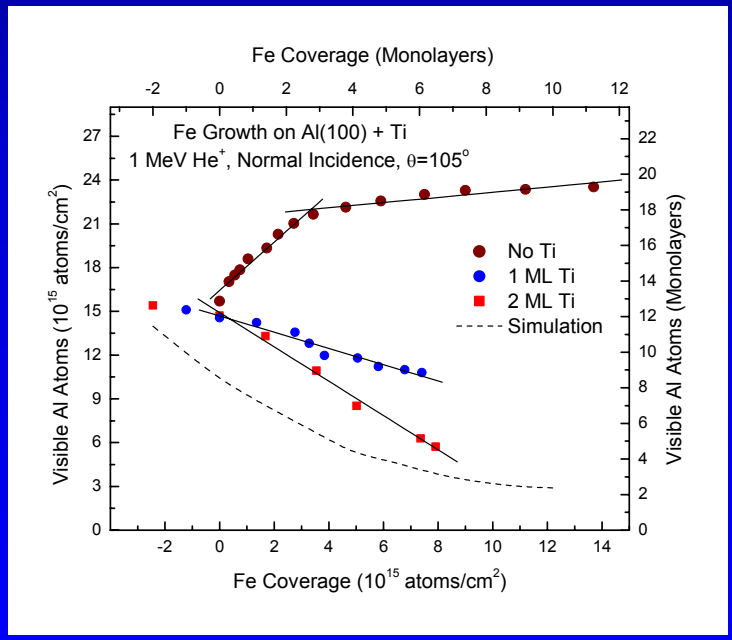

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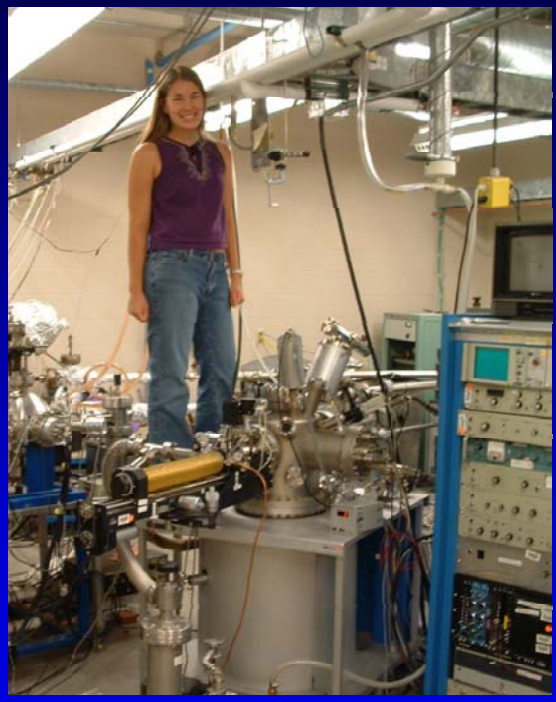
Support of the Ion Beams Group at MSU makes possible not only the research projects, but also the associated training of undergraduate and graduate students, and postdoctoral visitors to the laboratory. We have developed several 4-week long student laboratory projects using the van de Graaff accelerator and other instrumentation maintained primarily through NSF support.

During the past three years we have supported 12 undergraduate students on research projects in our lab. These students come from Physics, Computer Science, and Engineering departments on campus. This was accomplished with an REU supplement to the NSF grant as well as an REU program at MSU. These students are co-authors on group publications. For three summers we have worked with a high school science teacher supported by NSF (RET) and the Murdock Foundation Partners in Science program. Laboratory facilities are used by visitors from universities and national labs through collaborations with the PI. We recently initiated a collaboration with Arcomac Surface Engineering, Inc., a new company in Bozeman, MT, to assist in development of thin film coatings. A new collaboration with G. Bozzolo, NASA GRC, will use our results to verify atomistic simulation parameters for modeling advanced aerospace materials.



Summer REU student, River Hutchison, from Harvey Mudd College, takes control of a Scanning Auger chamber used for thin film studies (Summer 2003).