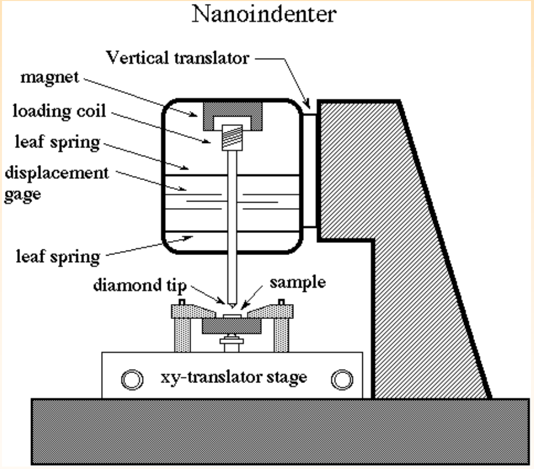
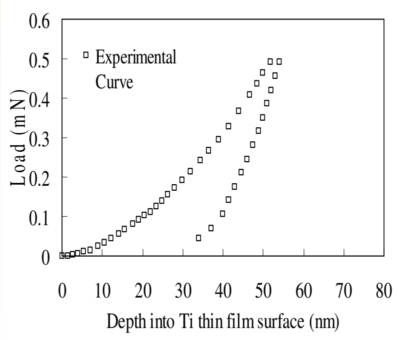
Nanoindentation Studies and Material Characterization

Post Doctoral Fellow: Zhaohui Shan **Faculty: Suresh Sitaraman**

Objectives

- Develop a methodology combining of nanoindentation and finite element modeling to characterize mechanical (elastic and plastic) properties of thin film.
- Compare the thin film properties with bulk material properties.
- Study the interfacial fracture behavior of Ti thin film on various substrates, such as Si wafer and Alumina (Al_2O_3) ceramic, by experimental and numerical methods.





Accomplishments

- Developed a methodology for evaluation of elastic and plastic properties of thin films in electronic applications, e.g., Ti thin film.
- It is found that the yield stress of Ti thin film is about three times the "bulk" value, while the elastic modulus did not change
- Methodology validated with its application on 7050 Al-alloy

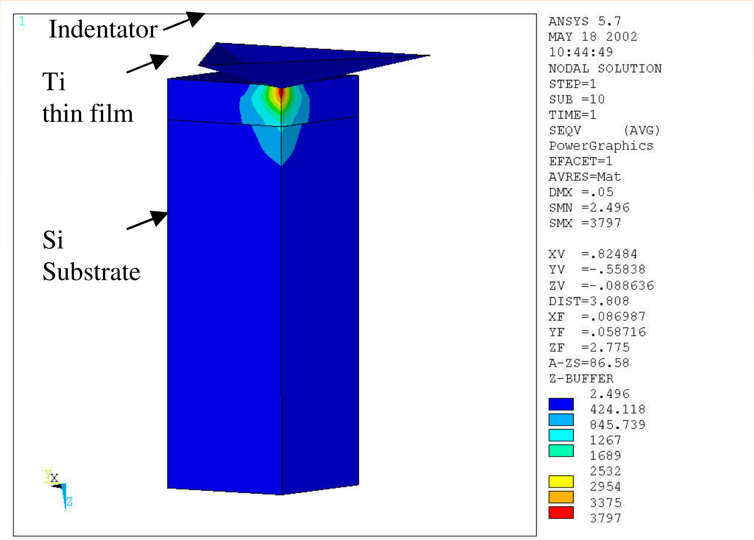
Approach

Experiments

- Prepare sample, for example, by sputter deposition of Ti on Si wafer
- Use Nanoindentation to measure load-displacement curve of Ti thin film

Modeling

- Incorporate internal stress in the Finite Element Modeling.
- Incrementally vary properties in 3D modeling to find a similar simulated load-displacement curve as compared with experimental one.
- Determine elastic and plastic behavior of thin films



Materials	Type and method	E (Gpa)	Yield stress (MPa)	Hardening n
Titanium	Thin film, by FEM	128	1200	0.27
Titanium	Bulk, from reference	120	200-400	0.14

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