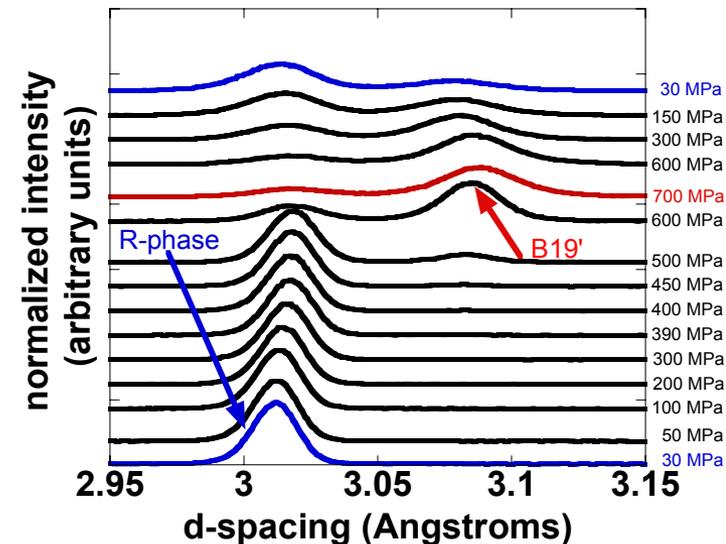
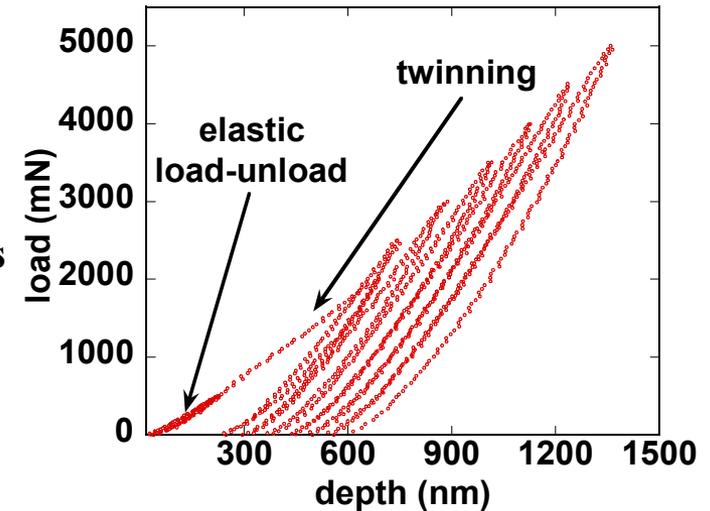


CAREER: Neutron, Synchrotron X-ray Diffraction and Instrumented Indentation Studies of Deformation in Shape-Memory Alloys

Raj Vaidyanathan, University of Central Florida

DMR 0239512 (Start date: February 1, 2003)

- The elastic modulus of B19' shape-memory NiTi was determined using three techniques; from the response of lattice planes measured using *in situ* neutron diffraction during loading, instrumented nanoindentation (see figure) using a spherical indenter and macroscopic extensometry. Twinning at stresses as low as 33 MPa was experimentally observed to lower the macroscopic Young's modulus determined (and previously widely reported) from extensometry.
- In collaboration with NASA, a low temperature loading capability for *in situ* neutron diffraction measurements was implemented on the Spectrometer for Materials Research at Temperature and Stress (SMARTS) at Los Alamos National Laboratory. The *in situ* diffraction measurements, during loading at 216 K (see figure), observed twinning in the R phase in shape-memory NiTiFe prior to a reversible martensitic transformation to the monoclinic phase at higher stresses. Comparisons with room temperature measurements from NiTiFe were also made.



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- The project is impacting four graduate students, one undergraduate, one high school student and one science teacher.
- Three graduate students traveled to Los Alamos National Laboratory for extended visits to receive training and perform experiments.
- A laboratory module incorporating the basic principles of shape-memory alloys has been developed for use at Satellite High School and will be implemented in the upcoming school year (see figure).
- Lectures on materials science and engineering (with shape-memory alloy demonstrations) have been prepared and regularly delivered to various student groups.

