Plastic Deformation

Dr. Pond has engaged and searched for an explanation of Professor James Bell's critical strain phenomena in crystal plasticity for decades. Undergraduate engagements on this problem have included a half dozen Hauber Research Fellows over the last fifteen years. Our research includes high-resolution laser metrology of plastic deformation gradients, stress birefringent measurements of plastic waves, electrical resistivity measurements to determine Poisson's ratio, hardness measurements of plastic gradients in rolled materials, and statistical analysis of stress strain curves.

Bell's critical strains in plasticity remain an anomaly. Students have developed information that promises an understanding.

NDE

Dr. Pond's extensive utility and industrial experiences have led to novel project activities including the measurement of post tension loads in nuclear containment tendon wires using sonic velocities, and non-contact sonic techniques for detecting spalling in concrete structures. His students have also participated in studies of phase transformations in aluminum alloys to determine the degree of corrosion sensitization using ultrasonic attributes. Students have also engaged in the use of scanning acoustic microscopy to determine the onset of stress corrosion cracking.

Corrosion

Engineering students have worked on Navy contracts examining the sensitization of aluminum alloy plate superstructures used on certain classes of ships. Students have discovered that non-invasive hardness testing is a way to discriminate the state of sensitization. This has led to the acquisition and use of to measure hardness.

Students have designed a novel technique to examine materials in-situ for the onset of stress corrosion cracking. The acoustic microscope is able to detect and map cracks down to 5 μm.

Alloys

An analogue of Wollaston wire was used to prepare shape memory alloy wires of aluminum-copper for potential use in deployment of arterial stents. The student did this work in conjunction with Johnston Matthey Platinum company.

Engineering Systems

Students have done research on novel production techniques for vacuum panels to augment harvesting of solar energy.

Work with a local machine manufacturing and in conjunction with Johns Hopkins University has led to the design and creation of a cellulose derived Silicon Carbide positioner that has a coefficient of friction lower than graphite.

Modeling

A team of students has recreated the Bragg bubble, 2-D bubble analogue of crystal structures, showing grains, grain boundaries, dislocations, and substitutional atoms. This model is instructive in qualitative descriptions of many phenomena in crystal physics. We are trying to use the technique to make relative determinations of strengthening mechanisms such as solution hardening. This is a work in progress.

Archeo-metallurgy

A current project is examining the efficacy of ubiquitous, linen armor that was used in the Mediterranean regions of the world 2,500 years ago. Students have designed a catapult for arrows and will generate variants of linen armor to learn how the Greeks manufactured this armor.