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Mechanics of Materials Laboratory

1. The activities of our group, in general, deal with experimental research to gain fundamental understanding of the deformation and failure of a wide range of materials (metals, foams, polymers, composites, honeycombs, fabrics, ceramics, rubber, …, etc.) and structures in various controlled environmental conditions. Areas of interest include plasticity, fracture, rate effect, temperature effect, time-dependent behavior, multiaxial (in-plane and axial-torsional-pressure) behavior, anisotropic behavior, size effect, manufacturing process, aging, etc. Typically, the work is tightly coupled with modeling effort.
2. Modeling is usually handled by designated modelers. We have worked with many of them, who are in CA or NM. In addition to the areas listed above, there are many more modeling areas at SNL. (Please let me know your interest, so I can be more specific.)
3. Experimental capabilities include a wide range of length scales, temperatures, loading rates, and diagnostics. There are more than 15 custom test frames in our laboratories, mostly MTS servo-hydraulic, some electro-mechanically driven. Capacities ranging from 2 million pounds to less than 1 μN/1 μm load/displacement resolution, quasi-static to 220 in/sec maximum. In addition to mechanical loading, various thermal loading systems (environmental chambers, quartz lamps, induction heating, resistant heating, heating tapes, etc.) can integrate with test frames. Diagnostics includes Laser displacement/strain measurements, DIC for field strain measurement, high-speed cameras (up to $2x10^6$ fps), high-speed/high resolution thermal imaging (IR) camera, and others. Example projects:
   - Foam (pressure sensitive material) triaxial (axial-torsional-pressure) deformation and fracture for model characterization and validation
   - Thermal-mechanical loading (axial-pressure-temperature) of steel shell structures including steel stress-strain curves from -150 to 1000 ^{o}C
   - Delamination of a Bi-material Composite
   - Biaxial failure strength of rivet joints
   - Large deformation uniform compression and non-proportional loading paths of metals
4. The Hopkinson bar lab has three systems (compression, tension and high temperature compression), a number of high speed cameras, data acquisition units, and laser gages. Recent activities:
   - Transverse wave of yarns
   - Dynamic fracture of composites
   - Dynamic tension of metals, joints, etc.
   - Dynamic compression of metals (including high temperature), foams, phenolics, etc.
   - PVDF calibration and its applications
5. Micromechanics Lab has an AFM, optical digital microscopes, and many loading stages for in-situ experiment, and scanning laser vibrometer and microprobes for MEMs and small structure/specimen analysis. The SEM and nano-indentation facilities are close by and easily accessible. Recent activities:
   - In-situ X-ray CT for damage evolution and failure of aluminum alloys
   - In situ AFM Study of Cracking and Buckling of Chromium Films on PET Substrates
   - Microscale discontinuous deformation measurement, DIC and others
   - Mechanical and thermal performance MEMS
   - ISDG technique and properties of Laser Welded Stainless Steel