High Strain Rate Measurements of Inconel 625 for Dynamic Forming Simulations

This project focuses on the mechanical behavior of Inconel 625 (IN625) at various temperatures and strain rates to better understand how the material behaves during dynamic metal forming processes. IN625 is a desirable material in many areas of industry for its high temperature strength, corrosion resistance, and its good formability and weldability. In dynamic metal forming processes, the material will be subject to high strain rates and temperatures so it is important to characterize its behavior under these extreme conditions. Specifically, the degradation of mechanical properties near 700 °C may involve the gradual growth of brittle carbides or precipitates, which introduces the possibility that the strength of IN625 is time-dependent under dynamic forming conditions, where heating times are short and strain rates are high. To probe this possibility, I use a specialized pulse-heated Kolsky bar to measure the mechanical response at high strain rates () in tension and compression and under rapid heating in compression up to 1000 °C. In addition, I use a servo-hydraulic test frame to measure the low strain rate response () in tension up to fracture. These data are used to calibrate the Johnson-Cook flow stress model, which can accurately capture strain hardening, strain-rate hardening and thermal softening in many metal alloys. The calibrated model will then be used to simulate the dynamic forming of laminate components for a heat exchanger to allow electricity to be created from high temperature waste heat from exhaust .