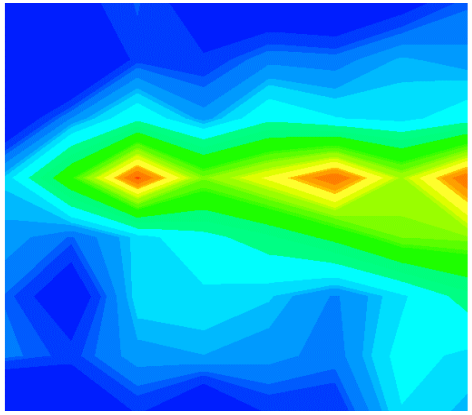
Dynamic Failure Mode Selection in Steels
High Speed IR Imaging

Ares Rosakis

Objectives:

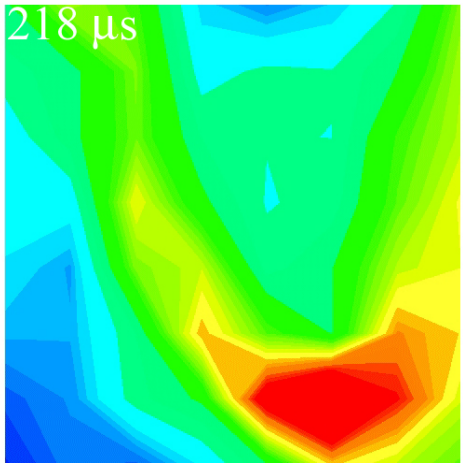
- Study the near-tip plastic zone structure of different materials/loading configurations using high speed microthermography (1mm by 1mm field of view, 1 million frames per second)



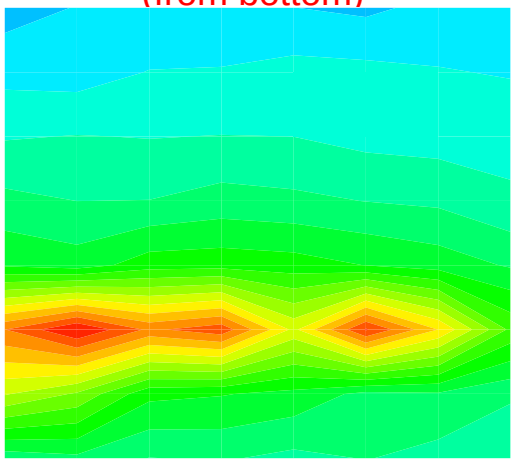
Bimaterial, intersonic shear crack (from left)

Significant Finding:

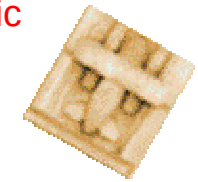
- Hot spots/vortical microstructures behind shear cracks and within shear bands
- Significant temperature rise at the crack tip (In steel ~50 °C for mode I, ~600 °C for shear bands)



Steel, mode I crack (from bottom)



Steel, dynamic shear band (from left)



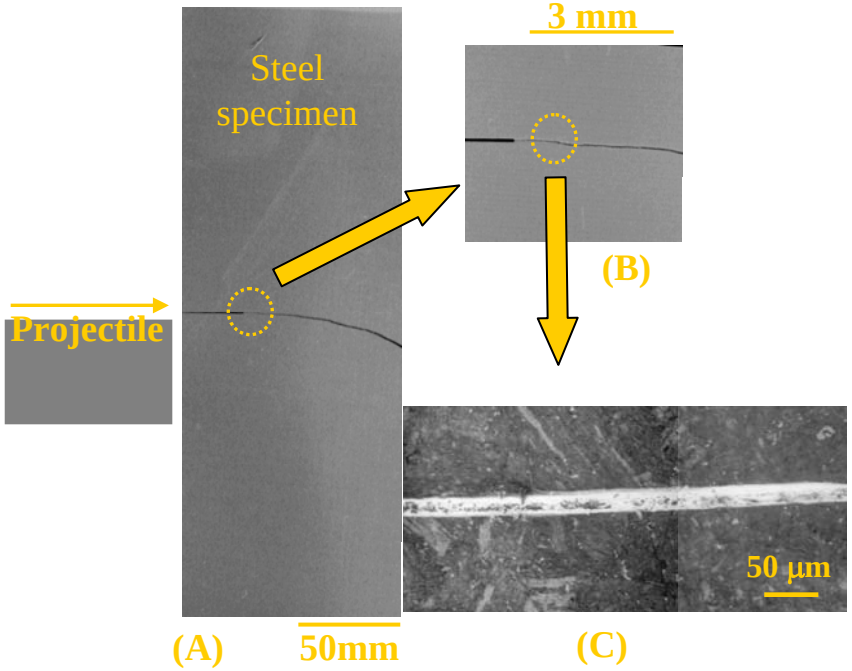
Payoffs:

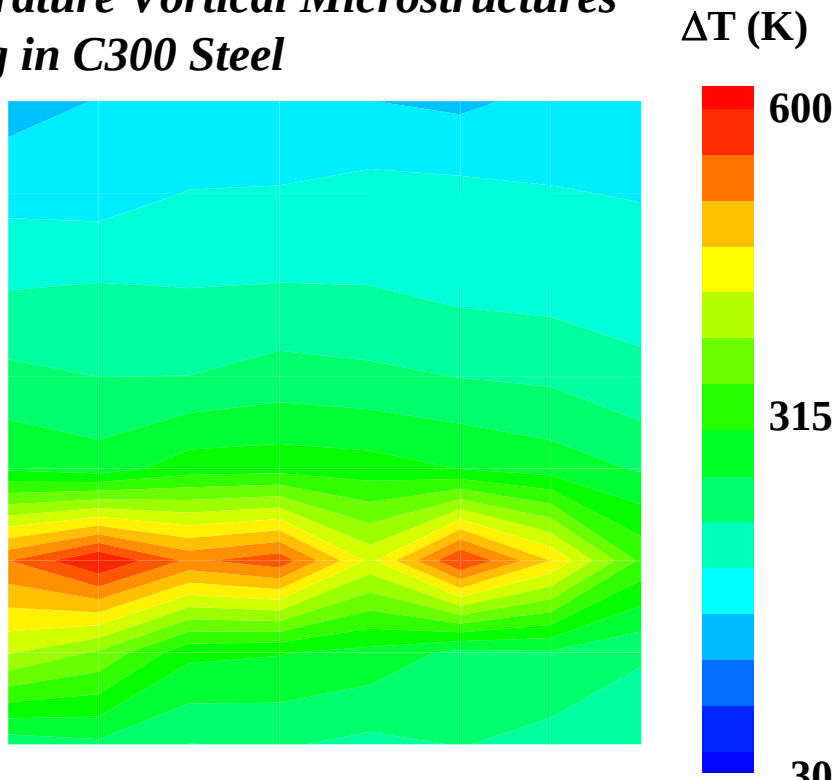
- Structure within dynamic shear bands and dynamic crack tips observed for the first time.
- Guidance and validation for computational models

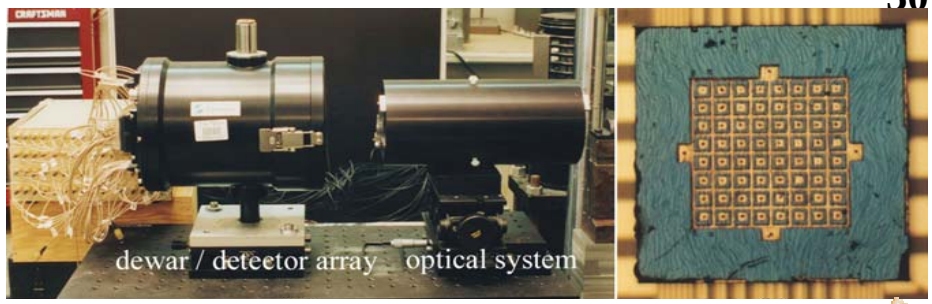
Ares Rosakis

VORTICES AND INSTABILITIES IN SOLIDS

Observations of Transient High Temperature Vortical Microstructures During Shear Banding in C300 Steel







- Shear band speeds: 1 km/s
- Framing rate: 1 million frames per second
- Guduru, Rosakis & Ravichandran (Physical review E, 2001)
- Coker & Rosakis (Philosophical Magazine A, 2001)