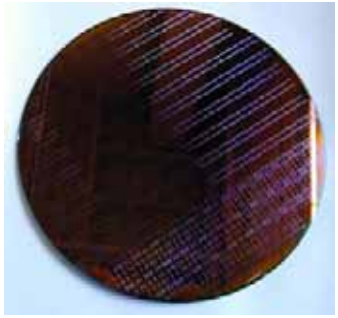
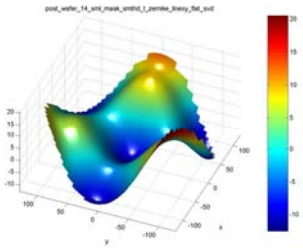
Ares Rosakis

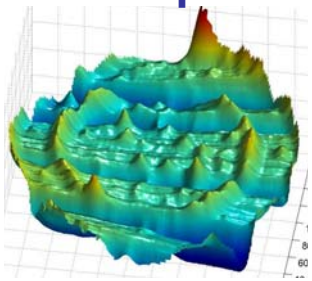
MICRO DEVICE RELIABILITY FACILITY

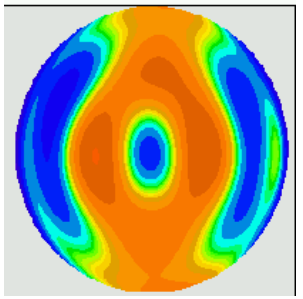


300 mm Wafer

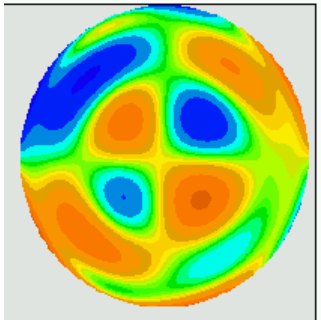


Shape

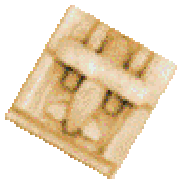




X Curvature, κ_{11}



Twist Curvature, κ_{12}



Measuring curvature and stresses in thin film structures deposited on wafers

G. Ravichandran

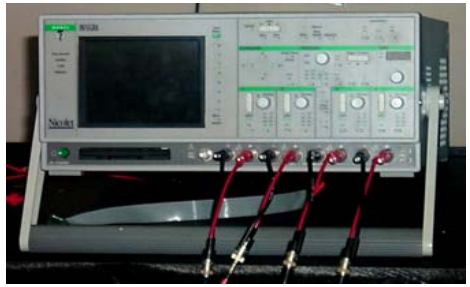
DYNAMIC CONSTITUTIVE TESTING LAB

- Split Hopkinson bars are available for constitutive testing at comparatively high loading rates (strain rates up to 104). Distinct systems exist for compression, tension and torsion testing. High-speed digital oscilloscopes have been acquired to facilitate data acquisition.

- **Split Hopkinson Bars**
  - ***Compression bar***
  - ***Tension bar***
  - ***Torsion bar***
- **Additional features**
  - ***High temperature capability***
  - ***High-speed temperature measurement***
  - ***High-speed digitial data acquisition***

Compression Bar

Torsion Bar

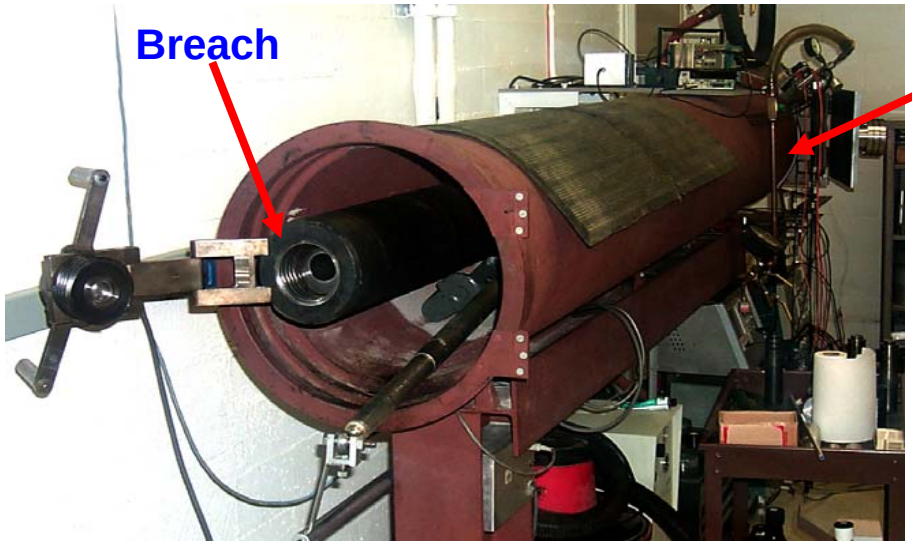


Nicolet Digital Oscilloscope

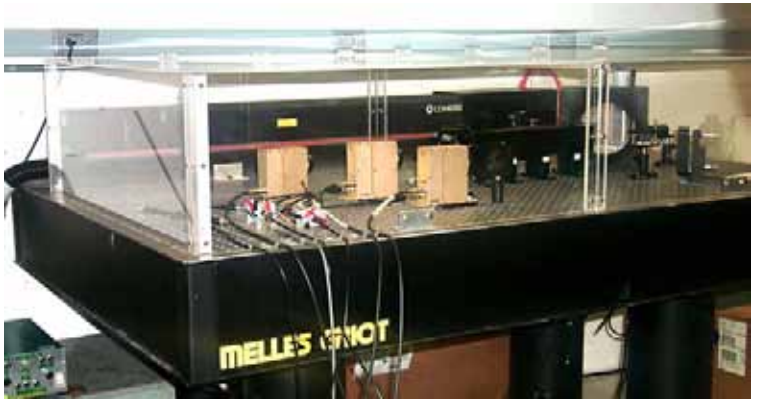
G. Ravichandran

PLATE IMPACT FACILITY

- The plate impact facility features a propellant gun for studies involving high speed impact and penetration. The system features a dedication VISAR for measurement of target velocity at the back surface and has been used in conjunction with other high-speed optical and infrared diagnostics.

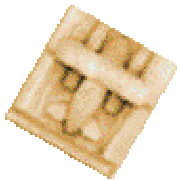


Propellant Gun



VISAR System

- **Plate Impact Facility**
  - ***Propellant gun with impact speeds from 200 to 2000 m/s***
  - ***VISAR system with adjustable sensitivity (83 to 1510 m/s per fringe) and 125 μm spot size***



Static Materials Testing Facility

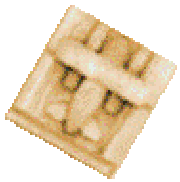
Ares Rosakis and G. Ravichandran

HYDRAULIC LOAD FRAMES

- **Two MTS axial-torsional load frames are available for testing at comparatively low loading rates. The system has been upgraded to include a state-of-the-art TestStar controller.**

- **Large capacity frame**
  - ***Model 319.25***
  - ***Axial capacity: 250 kN***
  - ***Torsional capacity: 2200 N-m***
- **Small capacity frame**
  - ***Model 358.10***
  - ***Axial capacity: 15 kN***
  - ***Torsional capacity: 150 N-m***
- **Control system**
  - ***TestStar IIm***
  - ***Digital control & data acquisition***
  - ***Acquired with CSEM funds***

MTS load frames with TestStar IIm control system



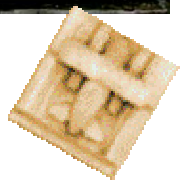
Dynamic Materials Testing Facility

Ares Rosakis and G. Ravichandran

- **A variety of loading devices are available to facilitate study of material behavior over a wide range of impact conditions.**

- **Air gun**
  - **Impact speeds from 10 to 200 m/s**
  - **Projectile masses up to 2 kg**

- **Drop Weight Tower**
  - **Impact speeds from 1 to 10 m/s**
  - **Drop weight mass of 250 kg**

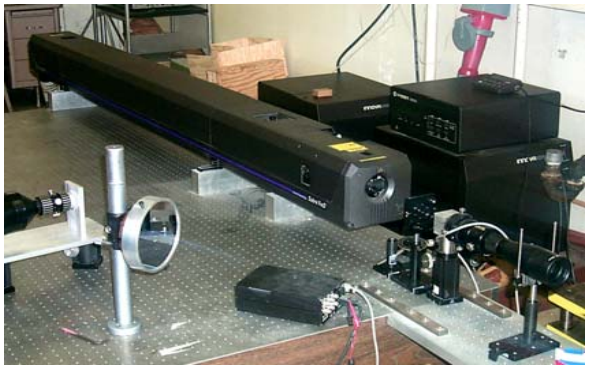


Ares Rosakis

HIGH-SPEED IMAGING F ACILITY

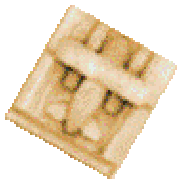
- High-speed imaging systems are available for the real-time visualization of dynamic deformation and failure. With a laser illumination source, optical interferometry is typically employed to provide quantitative information regarding the evolution of deformation and failure on a microsecond time scale.

Cordin 330A High-Speed Film Camera



Coherent Pulsed Ar-Ion Laser

- **High-speed film camera**
  - ***Cordin Model 330A***
  - ***2 million frames/second***
  - ***80 frames***
- **Pulsed laser system**
  - ***Coherent pulsed Ar-Ion***
  - ***Pulse duration: 10 ns***
  - ***Pulse rate: 5 MHz***
  - ***Synchronized with camera***



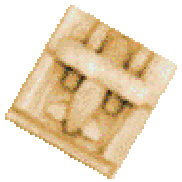
HIGH-SPEED IMAGING FACILITY (Cont'd)

Ares Rosakis and G. Ravichandran

Cordin 220-16 High-Speed Digital Camera

- **High-speed digital camera**
  - ***Cordin Model 220-16***
  - ***100 million frames/second***
  - ***Intensified CCD system (electronically shuttered)***
  - ***16 frames / 800 x 600 pixels***
- **Laser system**
  - ***Coherent Ar-Ion***
  - ***10 watts continuous***

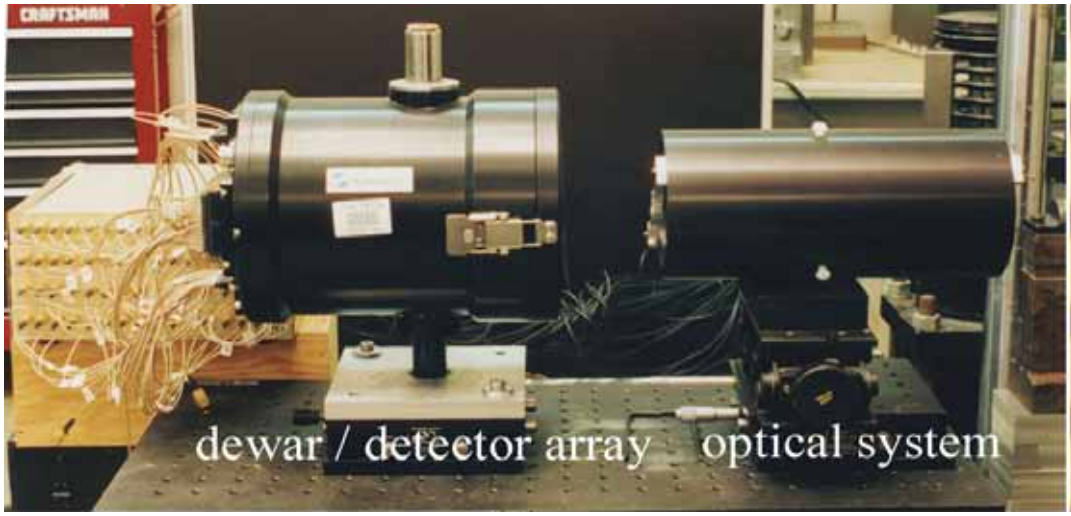
Coherent Ar- Ion Laser



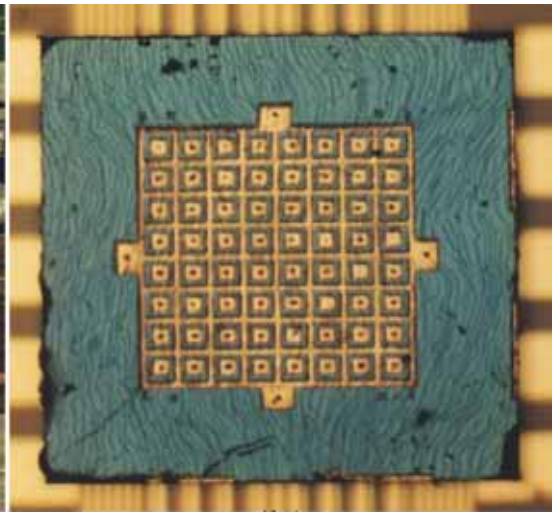
HIGH-SPEED IR VISUALIZATION LAB

Ares Rosakis and G. Ravichandran

- High-speed IR detector systems are used for the determination of transient temperature response of materials subjected to dynamic loading.



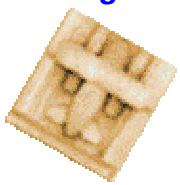
High-speed IR Camera System



Detail of detector array

- **High-speed IR camera**
  - *8 x 8 square array of HgCdTe elements (1.1 mm square)*
  - *Telescopic optical systems for 0.5 to 3 times magnification*
  - *Multi-plexing data acquisition system*
  - *1 million frames per second*
  - *Highest sensitivity to temperature changes from 275 to 500 K*

- **Linear detector array**
  - *16 InSb elements*
  - *80 μm elements, spaced 100 μm apart*
  - *Highest sensitivity to temperature changes from 400 to 1500 K*
- **Single detector**
  - *HgCdTe element*
  - *Used with Hopkinson bar*



Ares Rosakis and Marc Adams (JPL)

Joint GALCIT/JPL Venture
Small Particle Hypervelocity Impact Facility (SPHIF)

In a joint effort, the Graduate Aeronautical Laboratory of the California Institute of Technology (GALCIT) and Jet Propulsion Laboratory (JPL) are putting together this new Test Facility. It will be located in the Firestone Building at GALCIT. In this facility, small silicate particles simulating micro meteors will be launched in vacuum at velocities up to 9 km/s. High speed optical and IR diagnostics will be used to investigate the basic mechanics of hypervelocity impact and to guide the design of shielding of JPL spacecraft.

Front View of -Vacuum Tank Section

Light Gas Launch System and Target Tank Dimensions