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Strain Localization During Slow Strain Rate Testing of Sensitized Al-Mg Alloys

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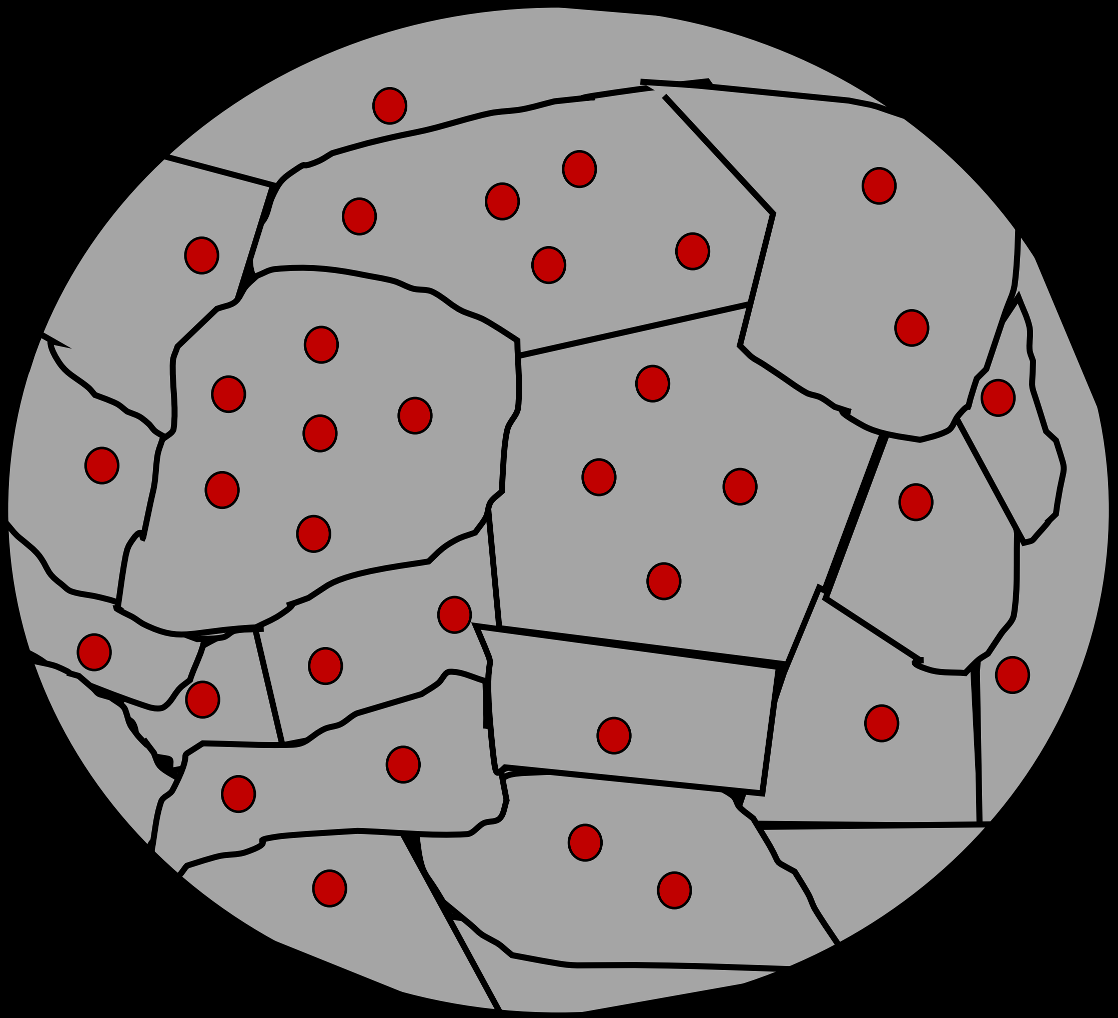
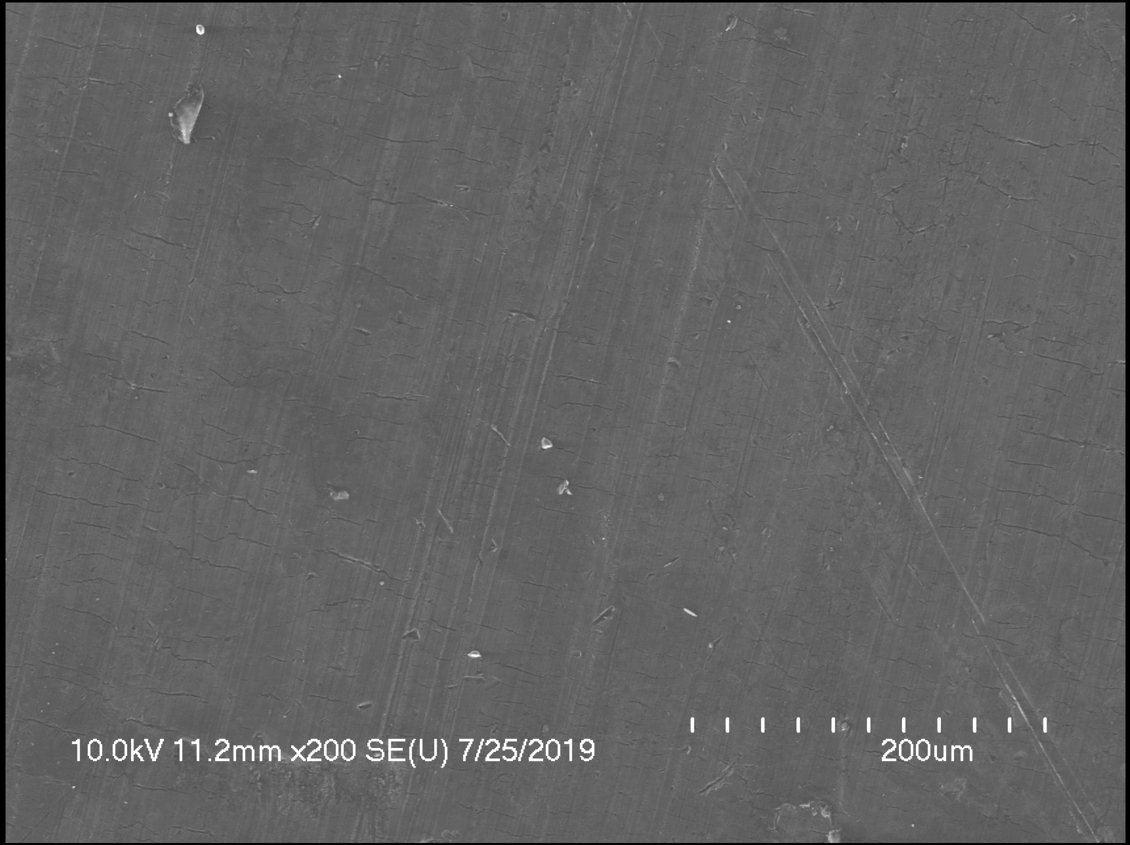
Background

- Aluminum (Al) is a desired commodity for its high strength to weight ratio and corrosion resistance, but pure Al is too soft for structural applications.
- Aluminum-Magnesium (Al-Mg) alloys keep the lightweight features while increasing strength, formability, and weldability. Yet, the magnesium segregation can lead to localized corrosion and stress corrosion cracking.
- Our objective is to understand the influence of different Navy-relevant environments on the ductility and mechanical properties of Al-Mg alloys.

Grain Boundaries



Salt Corrosion Effects

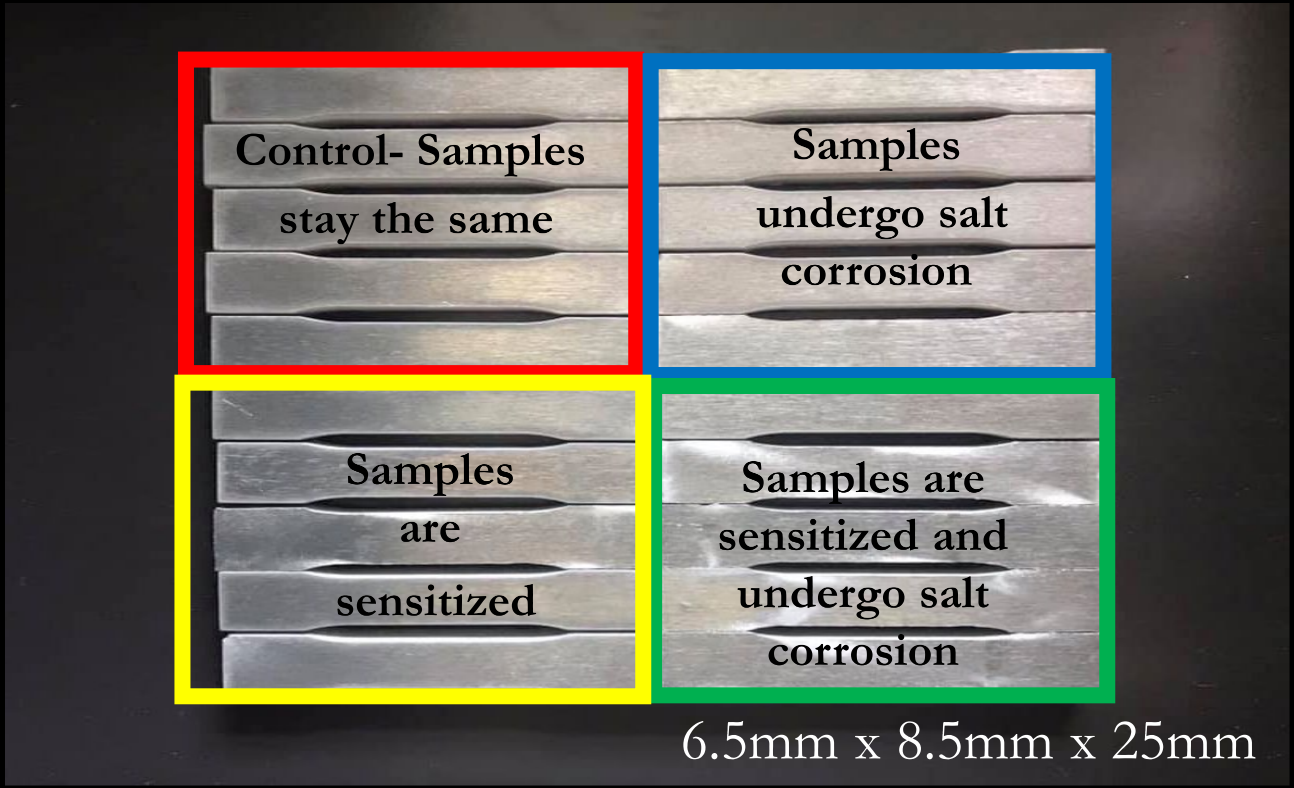


Al 5456 Alloy Samples

Al 5456 = Al with 3% wt Mg

Sensitized Samples

Put in furnace for 48 hours @175°C



Salt Corrosion Samples

Put in salt water solution (3.5% wt NaCl in H20) for 10 days

Ways to detect brittle/ductile fractures

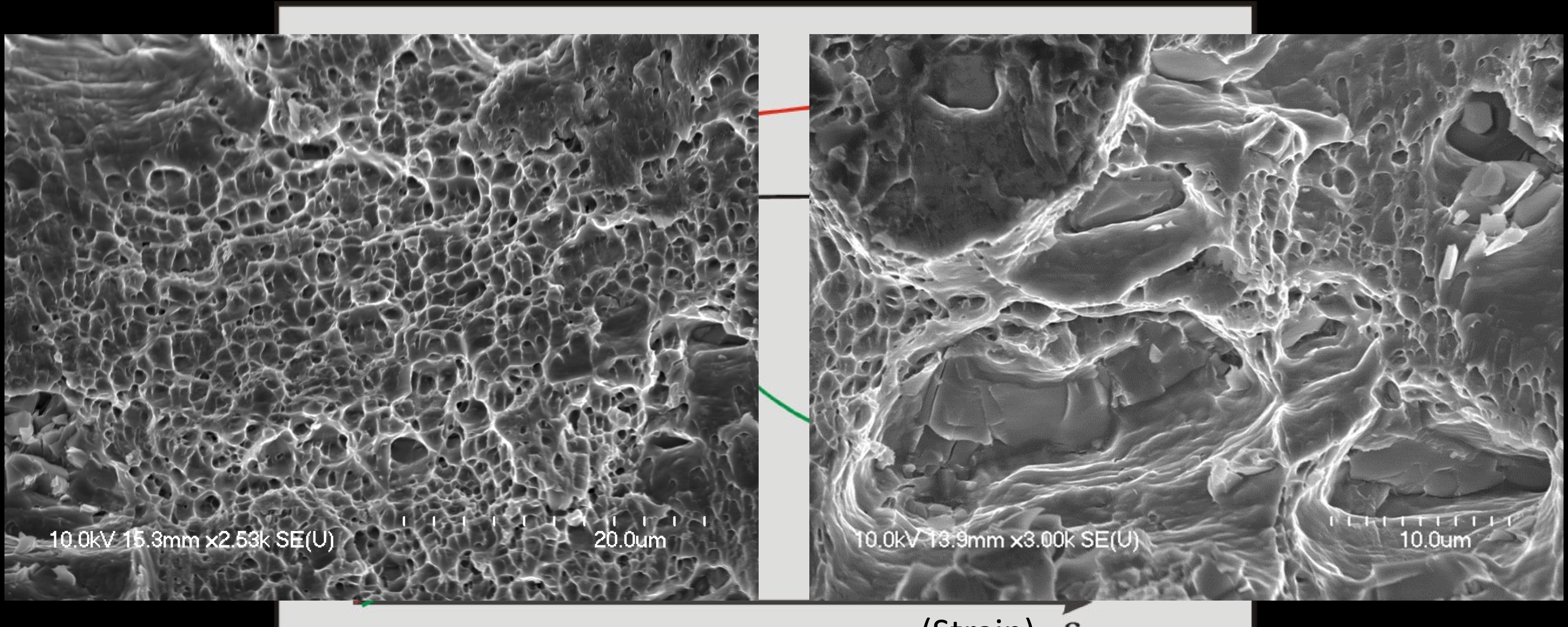
1. Stress Strain Curves from the Instron

2. Observing the Fracture Surface on SEM

Brittle vs. Ductile

1. Stress Strain Curves

2. SEM Images

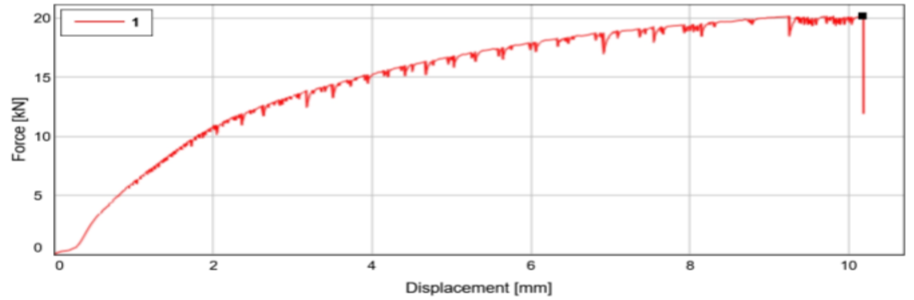


Ductile

Brittle

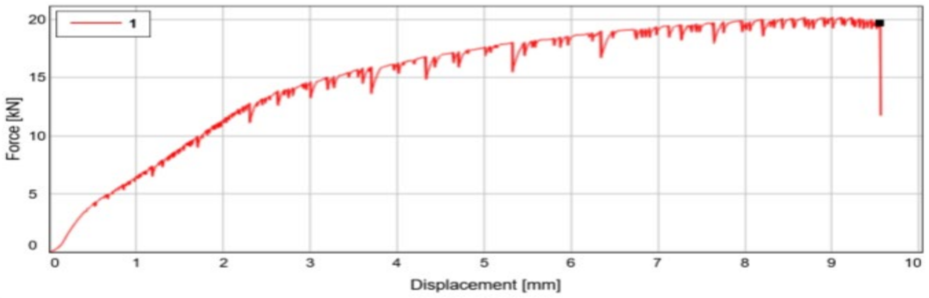
Stress Strain Curves

Control



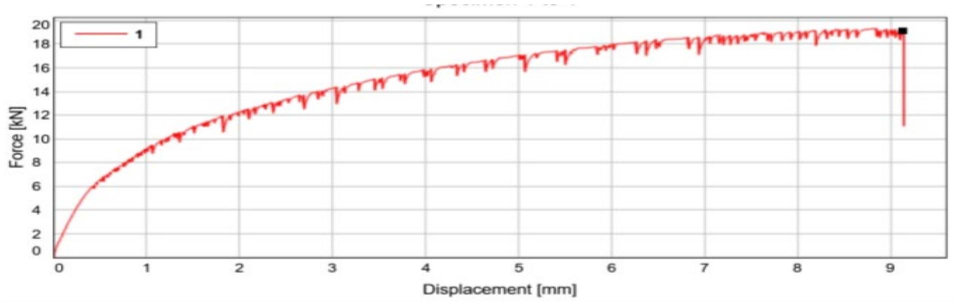
	Displacement at Break (Standard) [mm]	Force at Break (Standard) [kN]	Maximum Force [kN]	Displacement at Maximum Force [mm]
1	10.18	20.17	20.18	10.18

Salt Corroded



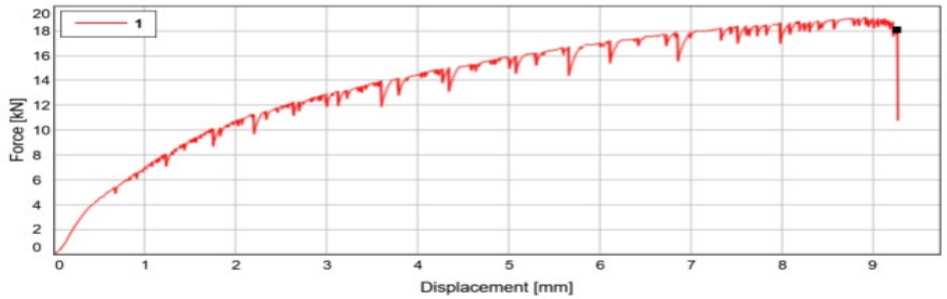
	Displacement at Break (Standard) [mm]	Force at Break (Standard) [kN]	Maximum Force [kN]	Displacement at Maximum Force [mm]
1	9.56	19.68	20.14	8.91

Sensitized



	Displacement at Break (Standard) [mm]	Force at Break (Standard) [kN]	Maximum Force [kN]	Displacement at Maximum Force [mm]
1	9.14	19.11	19.32	8.85

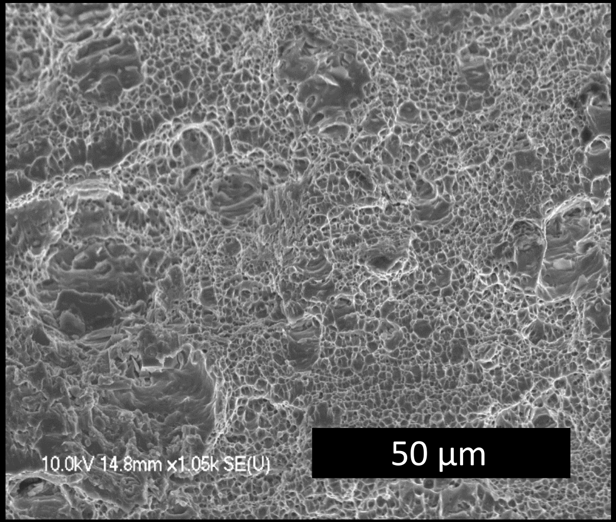
Salt Corroded & Sensitized



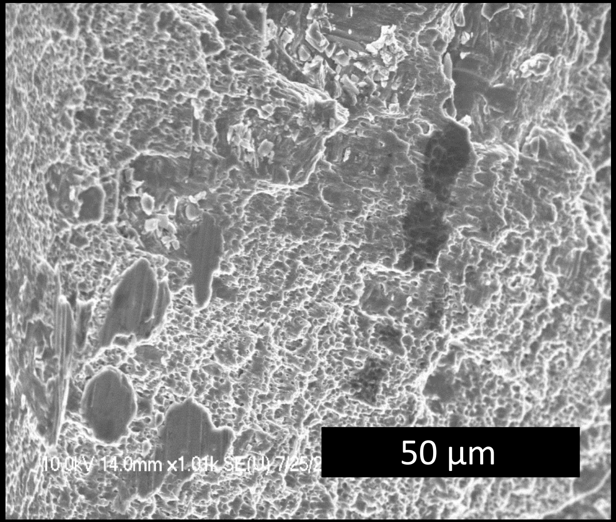
	Displacement at Break (Standard) [mm]	Force at Break (Standard) [kN]	Maximum Force [kN]	Displacement at Maximum Force [mm]
1	9.27	18.08	19.08	8.91

SEM Images

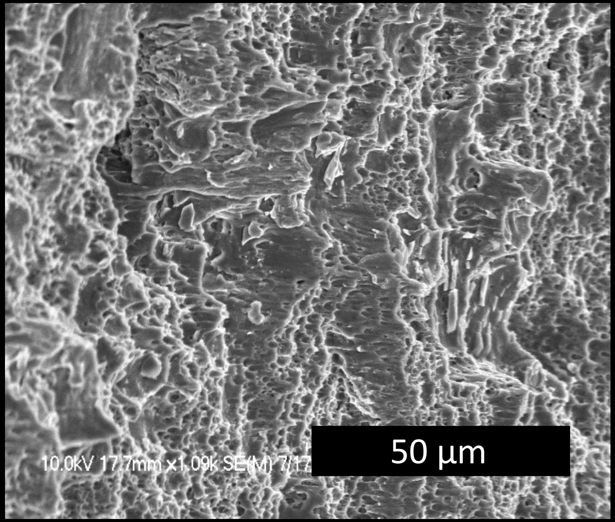
Magnification = 1000 ± 10



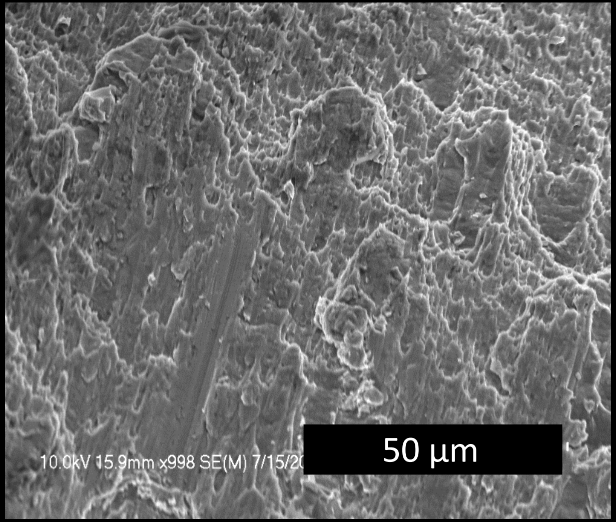
Control



Sensitized



Salt Corroded



Sensitized and Salt Corroded

Further Work

- Perform EBSD (Electron Back-Scattering Diffraction) on samples to understand what boundaries are cracking
- Work with computer modeling group to understand physics of hydrogen embrittlement
  - This information is going to be used to put into a computer model to help design materials to be more resistant to brittle fracture.

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