



For Want of a Nail: How Small Things Make Big Differences

Board of Regents Joint Meeting

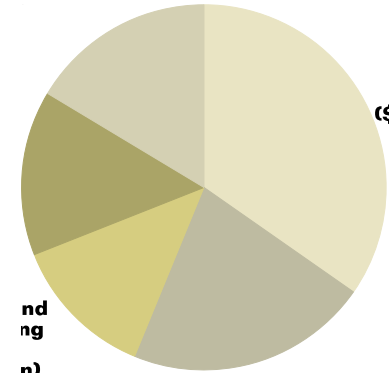
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Background

- Involved with construction and restoration projects while growing up in Utah
- Received BS in Metallurgical and Materials Engineering from Colorado School of Mines in 2010
- Began PhD in Materials Science and Engineering at WSU in 2011
- Interned at Nucor Steel Decatur during undergrad and at Sandia National Labs in Livermore, CA as a grad student
- Long term goal to run a small consulting firm providing corrosion and materials reliability solutions to a variety of clients

Materials Reliability Issues cause Big Problems

- Corrosion and materials reliability issues cost industry millions of dollars each year
 - Corrosion costs total about 3% of U.S. GDP annually

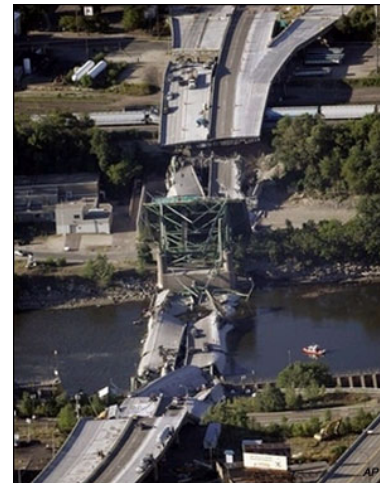
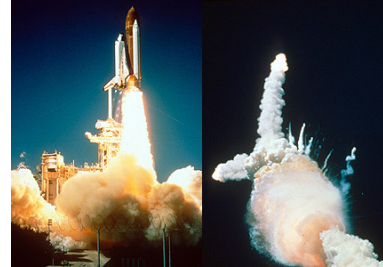


- Engineering or materials design flaws lead to devastating failures

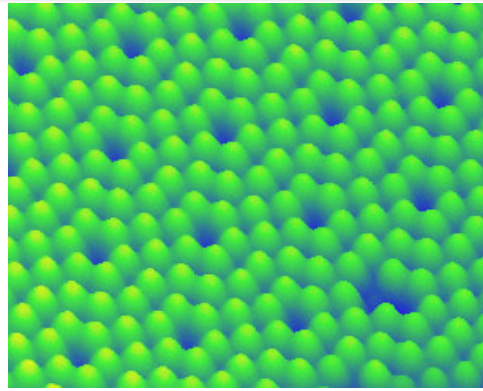
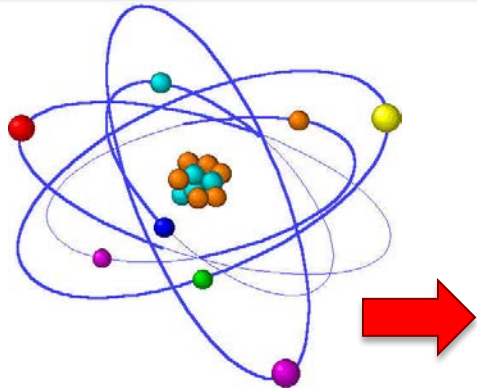


Why Care about Small Stuff?

- Failures fall in to two categories:
 - 1. Failure due to insufficient understanding of materials performance limits
 - 2. Small flaws cause problems for big components
- Components fail because they wore, corroded, or cracked in an unexpected way



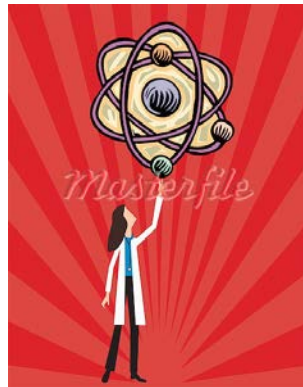
How Small is Small?



Components break because the bonds between atoms break

GOAL: Understand the mechanisms that cause atomic bonds to break which can ultimately lead to the creation of materials with stronger bonds.

Stronger Bonds (atomic scale) = Stronger Materials (large scale)



Materials Genome Initiative

- The White House sponsors advanced materials research to “Speed our understanding of the fundamentals of material science, providing a wealth of practical information that entrepreneurs and innovators will be able to use to develop new products and processes.”
- WSU is uniquely placed to achieve the goals set out by the Initiative through advanced testing laboratories and collaborative efforts.



**Sandia
National
Laboratories**

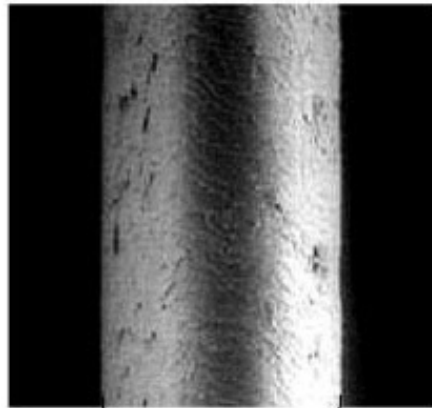


My Research: Small Volume Testing

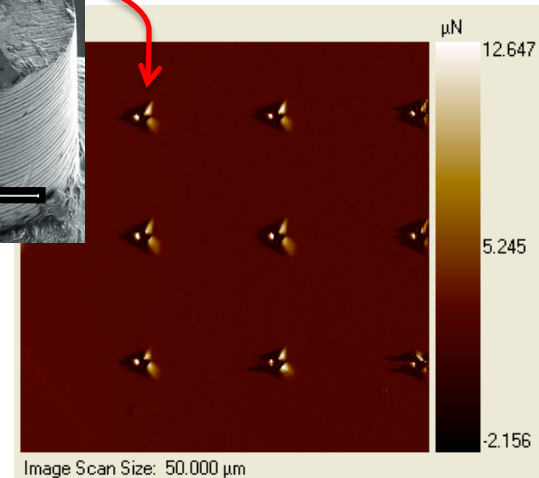
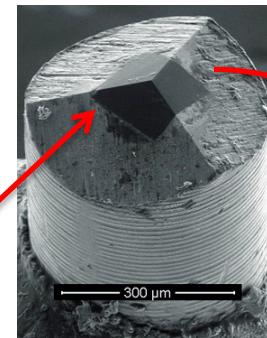
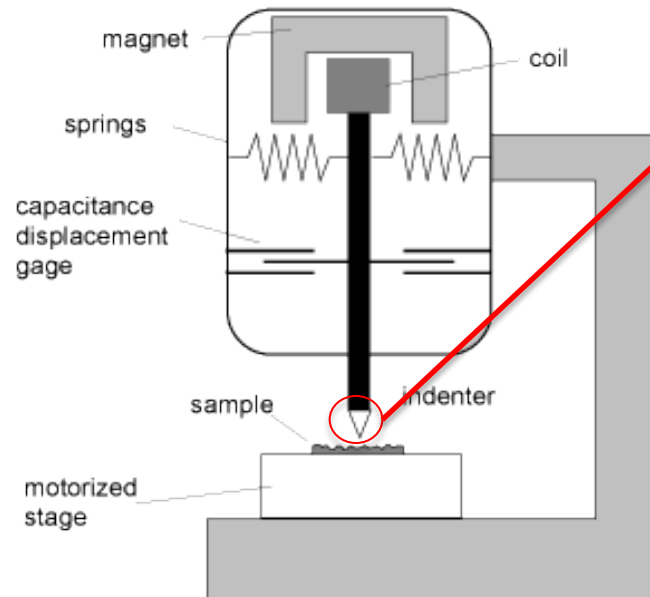
- Testing large samples is like finding a needle in a haystack



- Find the needle, make the haystack smaller. Isolate material properties to targeted regions.



Human Hair
(60 μm diameter)

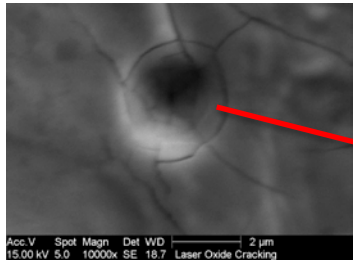


Research for Next-Generation Materials

- Test small-scale to improve performance at large scale.
- **Materials Tested:** Ni-based Superalloys, Stainless Steels, Pulsed Laser-Fabricated Oxides on Ti and stainless steel



- **Why these materials?** Used as components and protective films in high performance applications.



*Create “tamper evident” seal
*Develop stronger, tougher engineering materials

