Smart Materials and Structures

Takehiko Hiraga,
The University of Tokyo

Kira Barton,
University of Michigan

Robert Shepherd,
Cornell University

Naoya Shibata,
The University of Tokyo

Geoff Brennecka,
Colorado School of Mines, USA

Hidehiro Yoshida,
National Institute for Materials Science, Japan

Smart Materials:

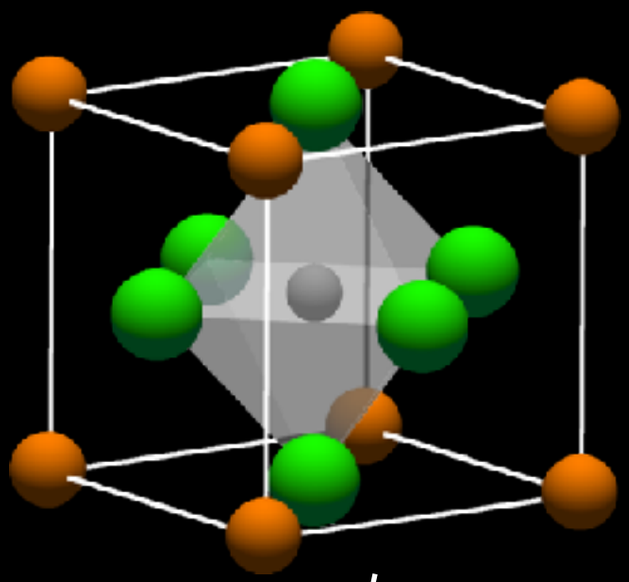
- Responsive in some useful (and often non-intuitive) way to some stimulus or stimuli
- Can be passive, active, or both
- Common examples include:
  - *shape memory alloys*
  - *electrochromic windows*
  - *self-healing structures*
  - *…*

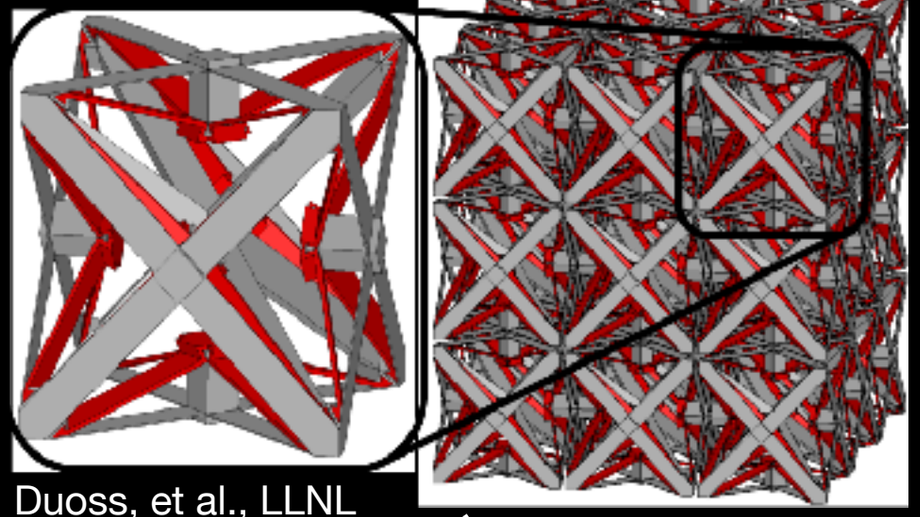
Don’t anthropomorphize materials…

They hate that.

deliberately oversimplified…

Input \ Output	Mechanical	Thermal	Electrical	Optical	Magnetic	Chemical
Mechanical	*elastic modulus, hardness*	*mechano-caloric*	*piezoelectric*	*tribo-luminescence*	*magneto-striction*	*mechanochem*
Thermal	*thermal expansion*	*heat capacity, thermal conduction*	*thermoelectric*	*emissivity*	*magneto-caloric*	*endotherm*
Electrical	*piezoelectric*	*Peltier*	*conductivity, permittivity*	*LED*	*induction*	*electrochemistry*
Optical	*photoacoustic*	*absorption*	*photoelectric*	*index of refraction*	*magneto-optics*	*photochemistry*
Magnetic	*magneto-striction*	*magneto-caloric*	*Maxwell*	*magneto-optics*	*permeability*	*magneto chemistry*
Chemical	*chem pressure*	*exothermic*	*electrochemistry*	*chemi-luminescence*	*redox mag*	*reactions*



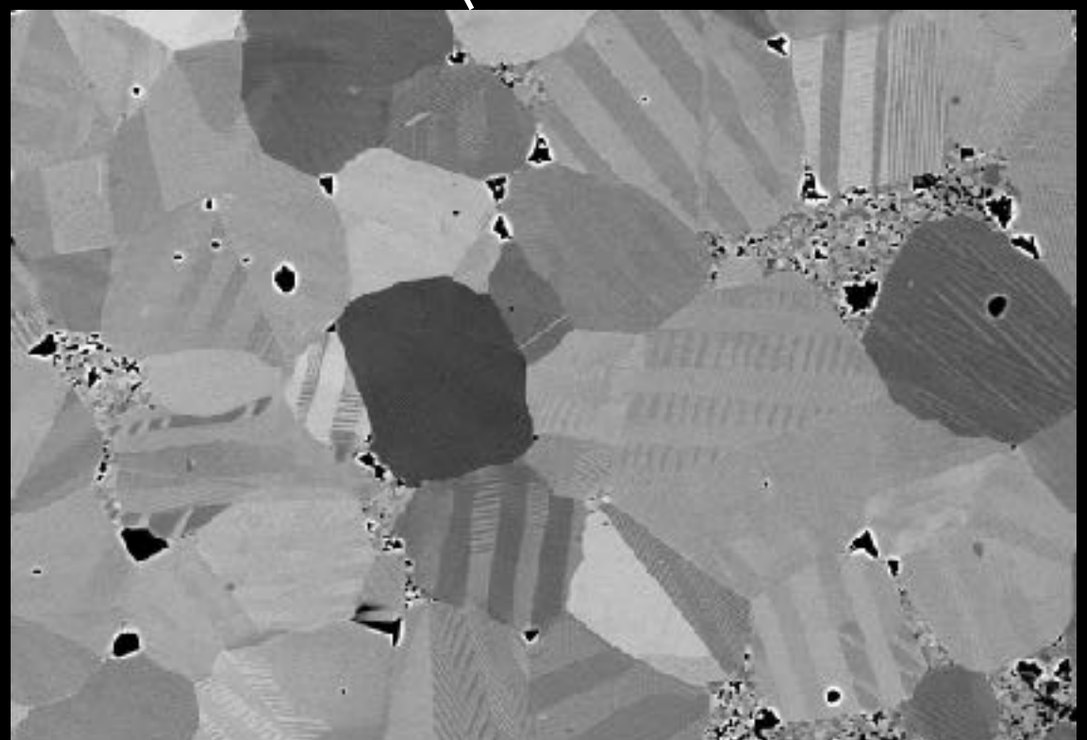


Duoss, et al., LLNL

by Kakidai

meters

10^{-12} 10^{-9} 10^{-6} 10^{-3} 10^{0} 10^{3} 10^{6}



by NASA

Any sufficiently advanced technology is indistinguishable from magic.

Arthur C. Clarke