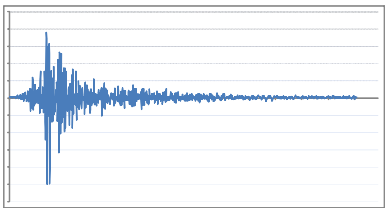
Andrew A. Shapiro

*Materials for Improving Robustness*

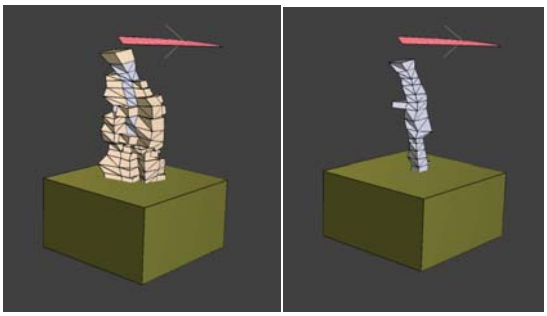
Our current work with Professor Daraio's group includes the modeling and application of materials for damping shock and vibration associated with launch environments. One and two dimensional non-linear materials are being developed targeting specific vibration and shock spectra that an instrument on a spacecraft may endure during its mission life. This work is in collaboration with Dr. Greg Davis and Dr. Peter Dillon.



Typical impulse spectrum from a mission event (courtesy Greg Davis).

*Evolutionary Design*

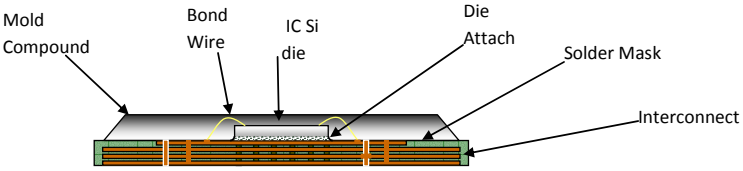
Designs of complex multi-material composite structures with improved properties are being performed with evolutionary development techniques in collaboration with Professor Erik Antonsson and Dr. Or Yogev. These evolutionary techniques lead to better design strategies when complexity is high. Designs with integrated multiple materials are being developed for fabrication using Laser Engineered Net Shaping (LENS) techniques.

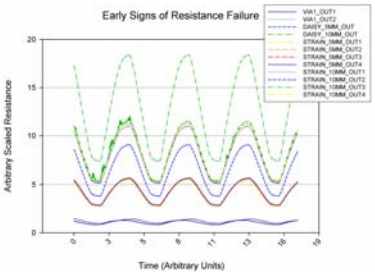


An evolutionary design of an inhomogeneous structure using a cell differentiation operation. The design on the left was evolved using two materials. The structure on the right is of one of the materials alone for the same structure (courtesy Or Yogev).

*Materials for Electronics in Extreme Environments*

My research interests include development of materials sets for extreme environmental exposure. Extreme environments include fatigue thermal-cycling such as that found in the Mars environment (-130°C-+20°C). The Martian day is about 25 hours. This means that for an extended mission of several years, the number of cycles will extend into the thousands. Current electronics can only survive in an enclosed, heated box which consumes energy and mass resources, making electronics that can withstand the extremes highly desirable.



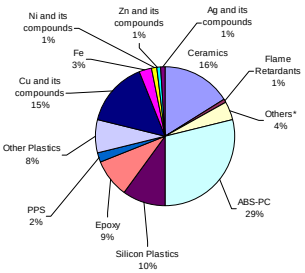



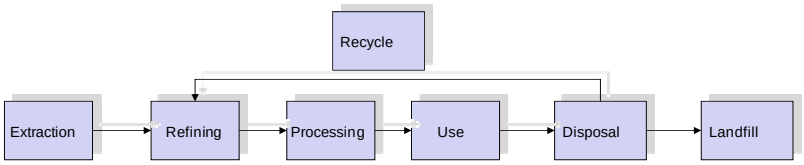

Chip-on-board assembly for extreme thermal environments and an in-situ measurement of this type of assembly from -130°C-+85°C.

Additional work is being performed on materials used in extreme cold applications anywhere from 90K down to <1K. Phase transformations of materials become problematic and are not well understood.

*Sustainable Fabrication*

Other research interests, in collaboration with UC Irvine, are in the area of sustainable manufacturing. The work is focused on reducing the environmental footprint of consumer electronic through analysis of the complete lifecycle and evaluation of environmentally friendly alternatives.




Composition (by weight) of a typical consumer electronic device and life-cycle analysis flow.