

ABSTRACT  
“3-D Printing of Ceramics via Robocasting”

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A revolution or cool useless parts? A brief perspective of 3-D printing of ceramic materials will be presented in general and more specifically for a technique known as robocasting.

With roots originating in Alfred, a journey from fundamental studies of colloids to an interesting processing technique to a small international commercial enterprise, Robocasting Enterprises LLC, will be described.

Robocasting is a specific subset of extrusion-based techniques for 3-D printing. Robocasting is the automated micro-extrusion of concentrated fine-particulate pastes that can transition from a yield-pseudoplastic rheology to a dilatant, solid-like state upon deposition thereby “curing” the particulate assemblage. Unique monolithic structures and composites may be printed. Further advances include conformal precision printing on existing components or non-planar substrates. Robocasting is particularly suitable for commercial-scale manufacturing of porous lattice structures and custom labware.

This presentation will be used to review robocasting from both engineering and commercial perspectives. From an engineering perspective, the fundamentals of manipulating inter-particle forces in concentrated colloids for the explicit utility of robocasting ceramics and composites will be discussed. Furthermore, the character and performance of lattices for filtration, catalyst supports, and load-bearing hydroxyapatite bone scaffolds will be reviewed.

From a commercial perspective, niche opportunities and the realities of transitioning from scientist to leader of a small entrepreneurial enterprise will be summarized.

**BIOGRAPHICAL SKETCH**  
**Joseph Cesarano III, PhD**

Dr. Cesarano was raised in Caledonia, NY and received a BS Suma Cum Laude in Ceramic Engineering from Alfred University in 1983 and an MS in Ceramic Engineering and PhD in Materials Science from the University of Washington in 1985 and 1989 respectively. He has been a Visiting Scientist at Oak Ridge National Labs and the Swedish Ceramic Institute. From 1989 – 2007 he was a scientist with Sandia National Laboratories and served as an adjunct professor in the Department of Chemical and Nuclear Engineering at the University of New Mexico and in the Department of Materials Science and Engineering at New Mexico Tech.

At Sandia he specialized in colloidal science and manipulation of fine particles for the development of material manufacturing technologies and process improvement. He has mentored over 50 students; several who are now university professors. He is an inventor of robocasting technology, has eight patents, three patents pending, and is an author on more than 30 technical papers. His publications on polyelectrolyte stabilization of ceramic particles are used in Materials Science curriculums world-wide and have been cited over 660 times.

In February 2007, Dr. Cesarano took an Entrepreneurial Leave from Sandia and began full-time operational control of Robocasting Enterprises LLC where he is currently the President.

He has a wife, Martha, a son Brad, a daughter Anna, and a dog Yoder.