Micro-Manufacturing and Multiscale Simulation Laboratory

Introduction

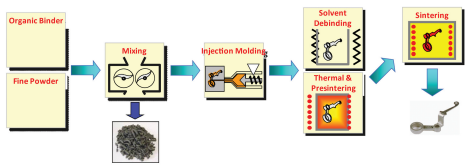
The micro-manufacturing (μ-manufacturing) of high-precision 3D products with sizes ranging from 10 μm to 1 mm for non-silicon materials is a major engineering challenge. The global technical community is making heavy investments in the research needed to meet the trends in industrial and military products that demand miniaturization. The needs include design flexibility, reduced energy consumption, and high accuracy, especially in the medical, biotechnology, telecommunication, energy, and automotive fields. In parallel, multiscale modeling and simulation is a rapidly evolving area of research that will have a fundamental impact on computational science and applied mathematics and will influence the way we view the relation between mathematics and science. The effort to combine these two technologies is under research with the following topics:

* The micro power injection molding (μ-PIM) of nanopowders based feedstock is being developed and used as one of the candidates in μ-manufacturing of metal, ceramic, and carbide materials with the aim to overcome mechanical and electrical property limitations of polymers - a currently winning material in μ-manufacturing. In order to keep the μ-PIM approach the size of powder should be less than 1/20 of smallest micro-feature (e.g. < 100 nm particle for 2 μm feature). Researches include the binder design and the rheological behaviour of binder-nanopowder mixture, micro injection molding, debinding, and sintering.

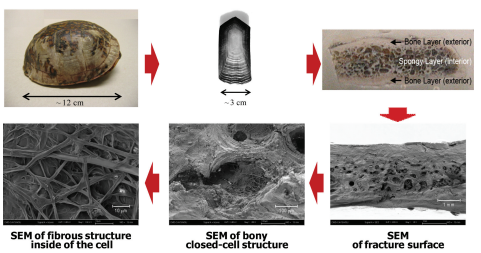
* Multiscale modeling and simulation (MMS) by integrating molecular dynamics (MD), discrete element (DEM), and finite element (FEM) simulations is under development for analyzing μ-manufacturing processes with material informatics. This research is possible through wide interdisciplinary collaborations with the physics, mathematics, and computer science departments. The multiscale simulation is followed by multiscale sensitivity analysis and multi-objective optimization for final μ-manufactured product of nanopowders.

* Bio-inspired design (BID) capitalizes on the rich source of design solutions present in biological materials by investigating the structure-property relationships with modeling and simulation. Current research includes turtle shell for armor design and bighorn ram for crashworthiness design. Investigated porous multiscale structure is made by μ-manufacturing process.

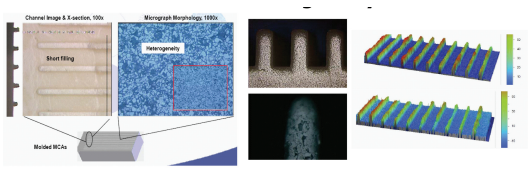
Micro Powder Injection Molding(μ-PIM)



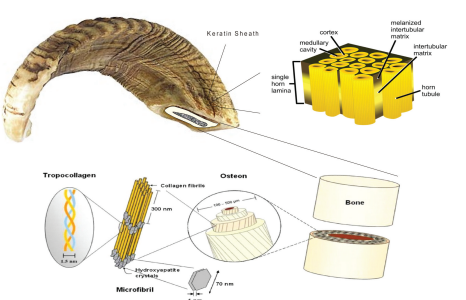
Multiscale Hierarchy of Turtle Shell



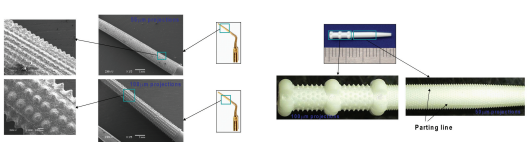
Issue of Homogeneity



Multiscale Hierarchy of Bighorn Ram



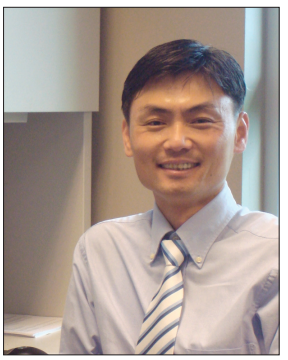
Medical Applications



Major Publications

- R. Damiens, H. Rhee, Y. Hwang, S. J. Park, Y. Hammi, H. Lim, and M.F. Horstemeyer, "Compressive Behavior of a Turtle's Shell: Experiment, Modeling, and Simulation," Journal of the Mechanical Behavior of Biomedical Materials, Vol. 6, 106-112, February 2009.
- Seong Jin Park, Michael W. Trim, M.F. Horstemeyer, "The effects of water and microstructure on the mechanical properties of bighorn sheep (Oviscanadensis)hornkeratin," Acta Biomaterialia, Vol. 7, Issue 3, pp. 1228-1240, March 2011.
- J. L. Johnson, S. J. Park, Y.-S. Kwon, and R. M. German, "The Effects of Composition and Microstructure on the Thermal Conductivity of Liquid Phase Sintered W-Cu," Metallurgical and Materials Transactions A, Vol. 41A, No. 6, pp. 1564-1572, June 2010.
- R. M. German, P. Suri, and S. J. Park, "Review: Liquid Phase Sintering," Journal of Materials Science, Vol. 44, No. 1, pp. 1-39, January 2009.
- S. J. Park, K. Cowan, J. L. Johnson, and R. M. German, "Grain size measurement methods and models for nanograined WC-Co," International Journal of Refractory Metals & Hard Materials, Vol. 26, Issue 3, pp. 152-163, May 2008.

Seong Jin Park



Education

Ph. D 1996 POSTECH (ME)
M. S. 1993 POSTECH (ME)
B. S. 1991 POSTECH (ME)

Experience

2012.02~present
Associate Dean of Research Affairs, POSTECH
Director Venture Incubating Center, POSTECH
Director, POSCO Liaison Center, POSTECH
2011.03~2014.02
Namgo Young Chair Professor Award, POSTECH
2010.09~present
Associate Professor, POSTECH
2009.07~2010.08
Assistant Professor, POSTECH
2006.01~2009.06
Associate Research Professor, Mississippi State University
2001.12~2005.12
Research Associate, Pennsylvania State University
2000.05~2009.06
Chief Technical Officer, CetaTech, Inc.
1996.11~2000.04
Research Engineer, LG Electronics, Inc.
1996.03~1996.10
Post-Doctoral Fellow, POSTECH

Contact

Tel: 82-54-279-2182
Fax: 82-54-279-5899
Email: sjpark87@postech.ac.kr