Purdue School of Materials Engineering and Purdue Center for Metal Casting Research

Present

Peter G. Winchell Distinguished Lecture Series Seminar

Date: Friday, March 22, 2013

Time: 3:30 Refreshments
3:45 Seminar

Place: ARMS 1010

PURDUE™ MATERIALS ENGINEERING

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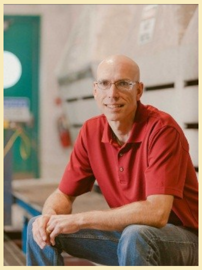

Thermodynamics, Processing, and Structural Evolution of Gasarite Metallic Foams

ABSTRACT

Gasarites were developed by Vladimir Shapovalov and co-workers in the former Soviet Union during the 1970's. Gasarite processing involves saturation of a metallic melt with a gas (hydrogen, oxygen, nitrogen) followed by directional solidification during which the gas forms porosity through a "gas-eutectic" reaction. The pore morphology is cylindrical or tubular with growth anti-parallel to the direction of heat extraction. The term "gasar" or "gasarite" is an acronym for a Russian expression meaning "gas-reinforced."

Many gasarite materials (e.g. Al, Cu, Fe, Mg, Mn, and Ni alloys) have been synthesized (Shapovalov, Nakajima), but the thermodynamics and kinetics are not well understood. Towards this end, our team at Michigan Tech is using an experimental and theoretical approach to explain the nucleation and growth of the tubular porosity in these materials. The basics of the "gas-eutectic" phase diagram for gasarite systems will be described, and some of the fundamental challenges will be discussed. Three processing methods (high-pressure, sub-atmospheric pressure, and thermal decomposition (e.g. TiH_2)) will be explained, and the morphology of the gasarites as a function of processing conditions will be assessed. For the thermal decomposition process, the key to producing high quality gaserites is balancing gas evolution and solidification rate.

SHORT BIO

Paul Sanders earned his BS in Metallurgical and Materials Engineering from Michigan Technological University and his PhD in Materials Science from Northwestern University. His PhD research was on the processing, structure, and mechanical properties of nanocrystalline palladium and copper. He post-doc'd at Argonne National Laboratory and Harvard University using lasers for solidification processing and material characterization. He then worked for 10 years on chassis materials (brake rotors and wheels) in Research and Advanced Engineering at Ford Motor Company. During that time he also worked at Jaguar Land Rover as a Six Sigma Blackbelt. For the last 4 years he has been an Assistant Professor in the Department of Materials Science and Engineering at Michigan Technological University. His Solidification Theory and Practice research team designs metallic alloys and processing for applications such as lightweight aluminum alloys for power train components, anisotropic gasarite structures for energy absorption, and high toughness ductile iron for wind turbines. He also advises the Advanced Metalworks Enterprise, a student-run engineering organization that executes industry-driven development projects.

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