Materials & Chemicals

Production of Nanoparticle Reinforced Metal-Matrix Nanocomposites from Master Nanocomposites

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Inventors: Xiaochun Li, Michael DeCicco, Dake Wang, Hongseok Choi

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a simplified method to produce nanoparticle reinforced metal-matrix nanocomposites.

Overview

A nanocomposite includes a matrix material to which nanoparticles (with a size of about 1.0 nm to a few hundreds of nanometers) have been added to improve a particular property of the material. For example, nanoparticles could be added to materials to make them lightweight and simultaneously improve the strength of the material. Materials with high strength-to-weight ratios are of interest to industries such as aerospace and automotive manufacturing. Materials processed with nanoparticles to yield lower-cost materials with the same strength properties as more heavy and expensive materials are desirable.

Metal-matrix nanocomposites are a type of nanocomposite in which nanoparticles are added to a metal-matrix. Metal-matrix nanocomposites can be made with relatively inexpensive materials with strengths comparable or even superior to expensive alloys. However, the methods required to produce these nanocomposites for certain material systems are expensive and not scalable to large foundry manufacturing systems. Specialized expertise and training are required to fabricate the nanocomposite. An improved, simplified method of producing a nanoparticle reinforced metal-matrix nanocomposite is needed.

The Invention

UW–Madison researchers have developed a method of producing a metal-matrix nanocomposite using a master material containing a higher percentage of wetted nanoparticles than the molten metal to which the master material is introduced. The master metal-matrix nanocomposite is introduced into a molten metal at a temperature above the melting temperature of the master metal-matrix nanocomposite. The master metal-matrix nanocomposite contains a first matrix metal and selected nanoparticles dispersed in the matrix metal. The first matrix metal may be an alloy containing a primary metal element and a wettability enhancing metal element. A portion of the master metal-matrix nancomposite is introduced by immersion as a solid or semisolid, or by addition as a liquid, and the master material melts into the molten metal. Then, the mixed molten metal solidifies to provide a second metal-matrix nancomposite containing a second matrix metal and at least a portion of the nanoparticles dispersed in the second matrix metal.

The use of a master nanocomposite allows the initial volume of metal processed with the nanoparticles to be reduced to a process in which the nanoparticles are added at their intended final concentration to a melt that will be added into the final nanocomposite. This enables the sale of solid master nanocomposites to foundries where they can be used easily to cast nanocomposites with desired nanoparticle concentrations without specialized training or expertise in nanoparticle handling and processing.

Applications

- Production of reinforced metal-matrix nanocomposites

Key Benefits

- Enables nanocomposite production on-site at foundries without complex nanoparticle handling and processing
- Utilizes wetted nanoparticles that do not float to the surface of molten metal during production
- Enables processing of smaller volumes of material than required for final casting

Additional Information

Related Technologies

- For more information about the formation of metal-matrix nanocomposites, see WARF reference number P05344US.

Tech Fields

- Materials & Chemicals : Composites
- Materials & Chemicals : Metals

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867