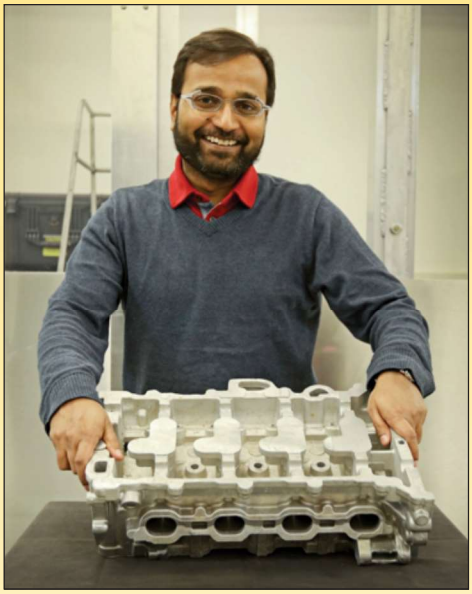
Commercialization of AlCuMnZr (ACMZ) Alloys



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Intellectual Property

Cast Aluminum Alloys with Improved Microstructural Stability and Strength at 350°C; ID-3569; 15/160,926

Aluminum Alloy Compositions and Methods of Making and Using the Same; ID-3804; 15/594,434

ID-3963: Heat Treatments for High Temperature Cast Aluminum Alloys and Components Fabricated from Them, 16/171,201

ID- 4221: High temperature cast aluminum alloys with improved ductility at lower temperatures, 62/774,468

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Problem: Realization of design opportunities for higher engine efficiencies in the global automotive industry demands new cast aluminum (Al) cylinder head alloys with higher strengths at higher temperatures (up to 300°C). However, despite decades of intense study, present commercial aluminum alloys for automotive engine applications are viable for temperatures only up to 250°C.

Solution: ACMZ alloys are a remarkable new family of cast aluminum alloys that combine unprecedented levels of cost competitiveness, castability, and mechanical property superiority at temperatures previously unattainable for lower cost Al alloys. At ORNL, a suite of atomic-level characterization and computation tools were applied to rapidly develop breakthrough alloys with unmatched yield strength and thermomechanical fatigue resistance at 300°C. In addition, the ACMZ alloys also possess superior hot tear cracking resistance, a problem common to all existing higher-temperature-capable aluminum alloys.

Impact: Cast ACMZ alloys provide an immediate upgrade over all existing commercially available cylinder head alloys by providing a >100°C increase in temperature capability, as well as substantial strength improvements. The primary industry that will be targeted for commercialization will be the automotive industry, including light- and heavy-duty engine manufacturers, casting suppliers, and original equipment manufacturers (OEMs).

Publications

- S. Roy, L. F. Allard, A. Rodriguez, T. R. Watkins, and A. Shyam, "Comparative evaluation of cast aluminum alloys for automotive cylinder heads: Part I - Microstructure evolution," *Metallurgical and Materials Transactions A*, Volume 48, Issue 5, pp 2529–2542, May 2017.
- S. Roy, L. F. Allard, A. Rodriguez, W. D. Porter, and A. Shyam, "Comparative evaluation of cast aluminum alloys for automotive cylinder heads: Part II: Mechanical and thermal properties," *Metallurgical and Materials Transactions A*, Volume 48, Issue 5, pp 2543–2562, May 2017.