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Dr. Amit Shyam is a senior research staff member in the Alloy Behavior and Design group in the Materials at ORNL. He has an undergraduate degree in materials and metallurgical engineering from the Indian Institute of Technology at Kanpur (1997) and a Ph.D. in materials science and engineering from Michigan Technological University (2002). His research interests include materials for automotive propulsion and lightweighting applications and design of alloys for structural applications. He has over 60 publications in addition to two issued US patents.

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

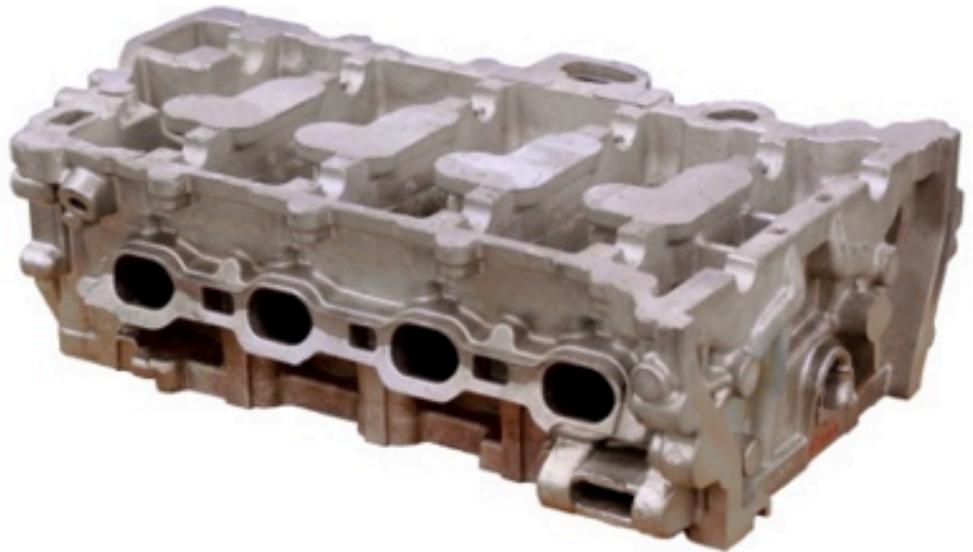
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Commercialization of AlCuMnZr (ACMZ) Alloys

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.