Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Magnesium Focus Area

Importance of Our Work

Lower cost and improved performance drive research in automotive applications. We are developing technologies to reduce magnesium costs, a material used since the 1930's to make pistons, engines and drive train components.

Benefits of Magnesium

- Reduced weight
- Improved fuel economy
- Improved environmental performance
- Increased safety and handling

Improved Processing/Properties

Thixomolding Creep Resistant Alloys
Thixomat Inc

Novel Production Methods

Solid-Oxide Electrolytic Membrane Direct Reduction of MgO
Boston Univ./ EIMEx, LLC

Recycling

Advances in Mg Recycling for Automotive Alloys
Case Western Reserve/Garfield Alloys

Joining

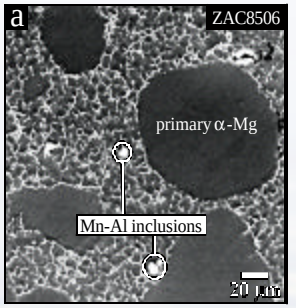
Friction Stir Welding of Mg-Mg & Mg-Al Sheet
Pacific Northwest internally directed research

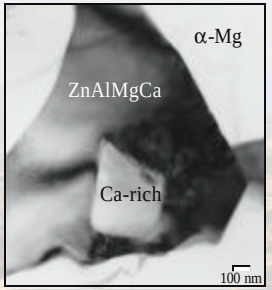
Improved Primary Alloy Production

Advanced Plasma Technology – Magnetherm Process
Northwest Alloys

Microstructural Characteristics of Creep Resistant Semi-Solid Molded Mg ZAC 8506 Alloy

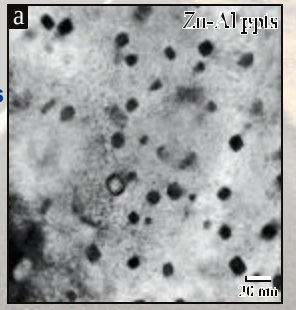
Thixomolded alloys have a unique microstructure that involves equiaxed nodules of primary a -Mg surrounded by the eutectic mixture of secondary a -Mg and a phase comprised of Zn, Al, Mg and Ca.

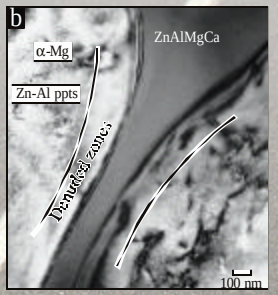




This phase was the last to solidify, and is enriched in Zn, Al and Ca.

Precipitation in the secondary a -Mg was observed, and appears to be cuboidal precipitates of a Zn-Al-Mg phase as yet unknown.





Precipitate denuded zones were observed in regions adjacent to the eutectic ZnAlMgCa phase. Some grain boundary precipitation was observed.

High Temperature-Creep Resistant Magnesium Alloys: Advances in Thixomolding for Automotive Components

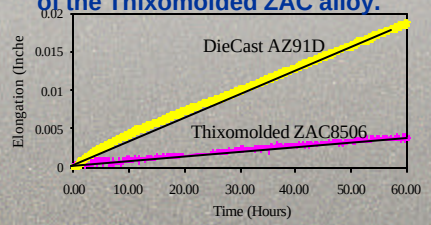
High temperature ZAC alloys (Mg-Zn-Al-Ca) have attracted interest due to their reasonable combination of cost, forming/processing characteristics and mechanical properties. In particular, the improved high temperature creep resistance of these alloys makes them candidates for automotive applications where the creep strength of magnesium is limited because the operating temperatures exceed approximately 125ºC.

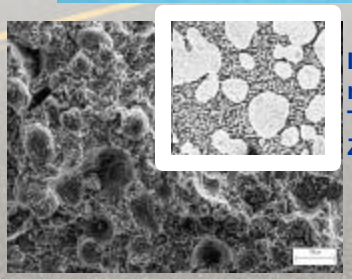
Thixomolded components by Thixomat Inc. and THX Molding/Phillips Plastics.
ZAC alloy compliments of IMRA America Inc.

Instrumented bolt load relaxation test assembly with instrumented

Delphi automotive electronics enclosure used to evaluate "moldability" of ZAC 8506 alloy

Compression creep results at 40MPa, 175ºC, expressed as Elongation vs. Time show the improved performance of the Thixomolded ZAC alloy.





Insert: Optical micrograph of Thixomolded ZAC alloy

SEM micrograph of Thixomolded ZAC showing alpha-Mg nodules surrounded by the interconnected eutectic matrix.