HyperCAST –

Vehicle Energy Efficiency via SHS Composite Cast Components (Funded by the US DOE)

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Collaborators

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Objectives

The program aims to develop high performance light weight aluminum and magnesium castings for energy efficient components for transportation. More specifically, the project aims to develop materials and processes for cast light weight frame, body, chassis, and power-train components for fuel efficient passenger cars and both commercial and military trucks.

Background

A self-propagating high-temperature synthesis (SHS) process is used to create the composite material. SHS is a process by which composites can be produced very rapidly utilizing the heat released from an exothermic synthesis reaction, such as

$$Al + Ti + C \rightarrow Al + TiC, \quad or \quad Al + Ti + B \rightarrow Al + TiB_2$$

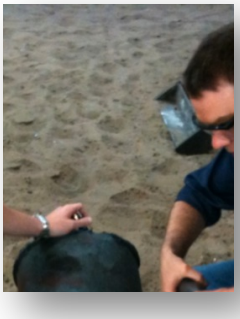
SHS-DC combines SHS with high pressure die casting (DC) to provide a rapid and affordable production route for manufacturing net shaped metal matrix composites.

Methodology

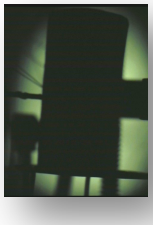
The process involves the following steps:

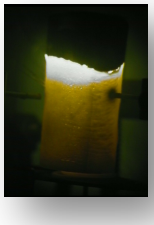
1. Adding powders of the reinforcing materials to the reaction vessel

2. Preparing an ignition source



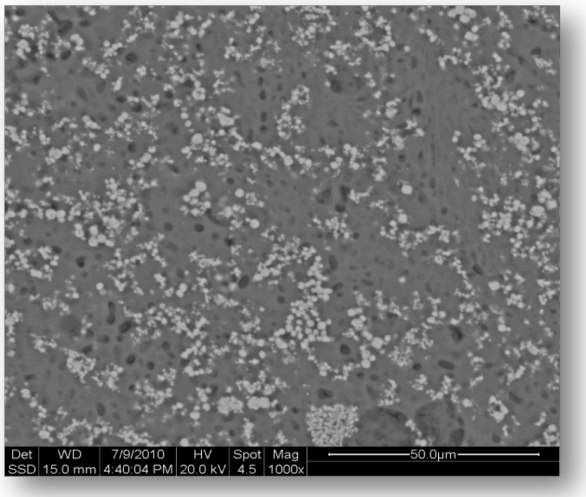
3. Ignite the material to initiate the SHS reaction

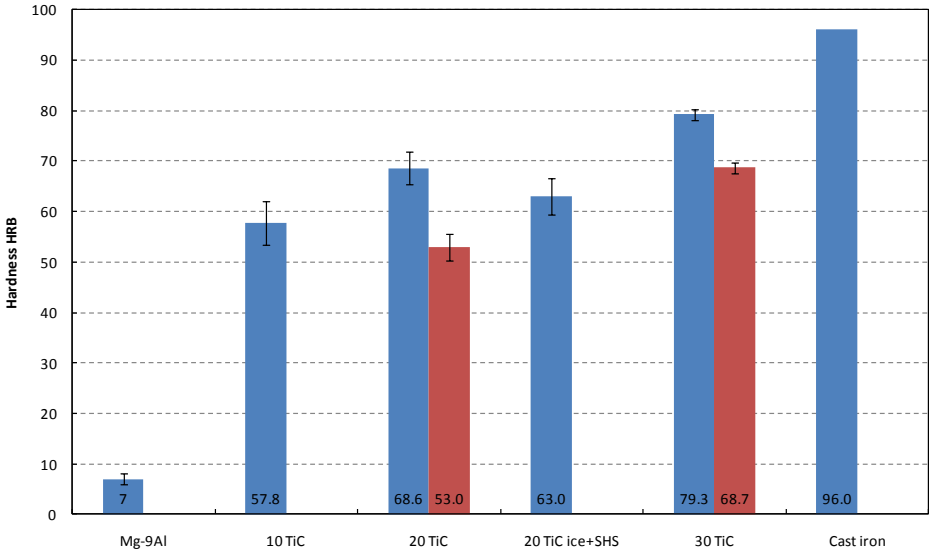





4. Allowing the material to cool and retrieving the billet

5. Cutting the billet into small pieces
6. Introducing the pieces into magnesium (or aluminum) alloy and melting at 750ºC
7. Making the castings by SSM, squeeze casting or high pressure die casting





Measured hardness of TiC-(Mg-based) alloy composite

Mg-9Al alloy

Mg-3Al alloy