Technology Project Abstract:
Melt R2-2: In-Situ Manufacturing of Nanoparticle Reinforced Aluminum Matrix Composites

Project Summary
This project intends to scale-up a process for producing aluminum-based nanocomposite material and develop process technologies for cast products with improved performance of large, single-piece cast products. The improved performance will increase stiffness and fatigue strength.

Technology Gap / Need
Aluminum alloys are used extensively in the automotive and aerospace industries because of their high strength-to-weight ratio. While some have very high strength, further strength improvements can be achieved by incorporating nano-sized particles in the aluminum matrix, as well as the mechanical properties at an elevated temperature. Monolithic aluminum alloys are not useful in such applications, so there is a need for a lightweight, thermally-stable material that can be produced economically with little disruption to existing manufacturing infrastructure.

Focus/Technology
Three routes have been identified. Each of the three process routes will be scaled up to produce several pounds of material. The material will then be cast in a laboratory and characterized by mechanical property and microstructural analysis in both the as-cast and heat-treated condition. Machining studies will then be conducted to determine the machining process parameters. The three process routes include:
- In-situ gaseous reaction
- In-situ self-propagating high temperature in the explosion mode
- Ex-situ ultrasonic dispersion

Project Benefits
The major benefits of this project are the reduction in component weight due to improved room temperature properties as the ability of aluminum to operate at higher temperatures due to better elevated temperature endurance.

Education & Workforce Impact
Students engaged with this project will be participating in real manufacturing environments and will be provided the opportunity to learn about aluminum nanocomposites, die casting and component design.

Project Duration
Start: March 2017
End: December 2018

Funding
Total Project Value: $2.3M

Participants
Industry Partners
NADCA
ECK Industries, Inc. Eaton
Terves
Nemak

Research Partners
WPI
Case Western Reserve University
University of Michigan
The Ohio State University
MIT