Research Programs

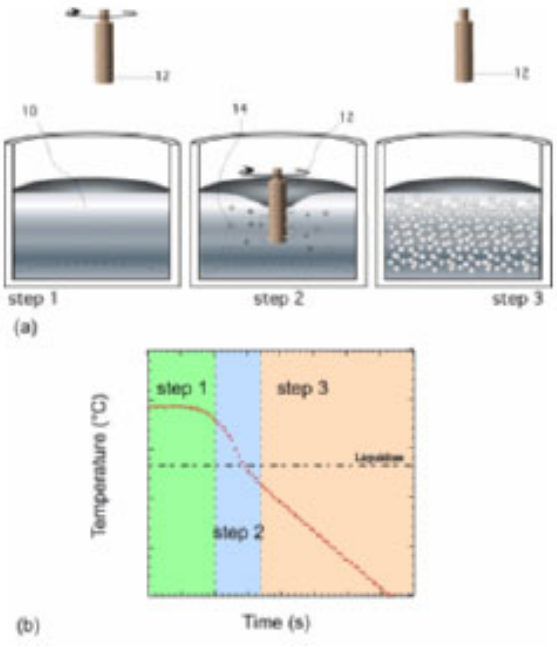
Microstructural Evolution in Semi-Solid Alloys: Efficient Formation of Structures Suitable for Semi-Solid Forming

Research Team:

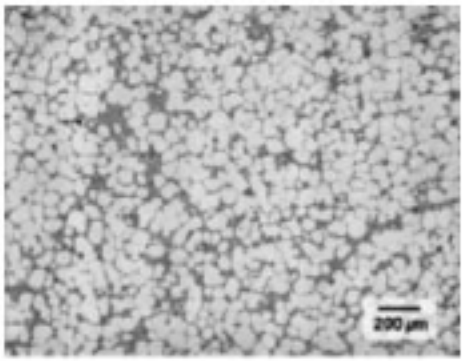
Raul Martinez
Anacleto de Figueredo
James Yurko
Merton C. Flemings

It is shown in this work that slurries ideal for semi-solid forming can be produced by stirring during the first small fraction of solidification, provided that stirring is combined with rapid heat extraction. Based on this finding, a new approach has been developed in which a rotating copper rod, initially at room temperature, is immersed in an A356 alloy melt held just above its liquidus temperature. Results show that good non-dendritic material, essentially free of entrapped eutectic, can be formed in this manner. Experiments were conducted in which either the stirring time or the rotational speed of the copper rod was varied. The microstructures of the alloy produced were compared to determine the influence of these process variables. The average shape factor of the primary solid was calculated and plotted as a function of both stirring time and stirring speed. The results show that even when the rotating rod was removed after the formation of as little as 1 vol.% solid, a non-dendritic structure is formed. The observation that non-dendritic structures can be achieved by processing during the small, initial interval in the solidification range is of enormous importance. Using the new approach, excellent semi-solid material can be formed from a liquid alloy in a simple and efficient manner, an ability that is becoming increasingly important for making semi-solid technology more economical.

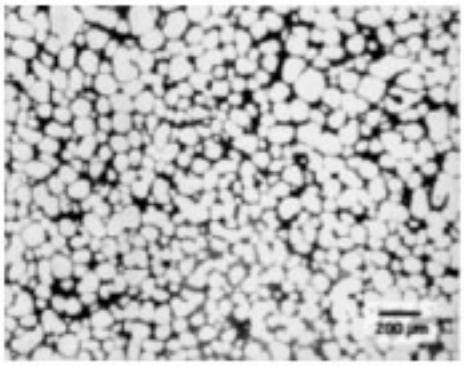
The MIT Process for Production of SSM slurries



Typical Microstructures of A357 Slurries Produced by the MIT Process



Processed Alloy, as-cast



Reheated to 585°C