Solidification and Scanning Electron Microscopy Analysis of Al-Ce Based Phases

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A recent interest has developed on the effects that rare earth additions, such as cerium, have on aluminum alloys to further increase the high temperature strength of autmotive alloys used for engine blocks, engine heads, and pistons. A notable increase in the yield strength and creep resistance at temperatures exceeding 300^{o}C were observed for an Al-Ce-Mg alloy as compared to a commonly used automotive, Al-Si and Al-Cu based industrial alloys. Optical microscopy, scattering electron microscopy (SEM) and in-situ solidification analysis using neutron diffraction was performed on various composition Al-Ce and Al-Ce-Mg alloys to characterize the microstructure and solidification kinetecs of the Al-Ce based phases. Two primary phases were identified, an Al-Ce-Mg fishbone structured phase and a blocky or "X" shaped Al_4Ce or $Al_{11}Ce_3$ phase. It is expected that the evolution and morphology of these Al-Ce based phases during the solidification and cooling of the alloy may be the main reason for the improved mechanical properties of the new Al-Ce alloys.