STRATEGIES FOR PRODUCING STRUCTURAL, HIGH-TEMPERATURE ALUMINUM ALLOYS USING RAPID SOLIDIFICATION METHODS

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The development of high-temperature aluminum alloys (HTAAs) relies on the ability to develop strengthening phases that are both thermally stable and finely distributed in the microstructure. Some of the most successful HTAAs developed to date contain fine distributions of intermetallic phases that are thermally stable and resistant to coarsening. In some alloys, such as the rapidly solidified Al-Fe-Si-V alloy RS8009, the strengthening phase is the quasicrystalline approximant (QA) α-$Al_{12}Fe_3Si$ phase (cubic Im-3 space group with a lattice constant of ~1.25 nm). In Al-Mn-Ce alloys on the other hand, the strengthening phase is the $Al_{20}Mn_2Ce$ phase (cubic Fd-3m space group with a~1.45 nm). For these alloys, Ce has been shown to destabilize the quasicrystalline phase observed in RS Al-Mn alloys and to favor non-QA phases. In both systems, there are several competing and less desirable phases due either to their coarser structures and/or lower thermal stabilities. In this presentation, the joint work between the Colorado School of Mines and the Universidade Federal de São Carlos on Al-Fe-V-Si and Al-Mn-Ce will be described. It will be shown that the mechanism of solidification varies significantly with cooling rate (undercooling) and alloy composition. The alloying and processing strategies that favor the desired phases over the less desirable phases will be described and discussed in some detail. *Some of the funding for this work was provided through the NSF I/UCRC Center for Advanced Non-Ferrous Structural Alloys and the characterization was conducted in the Electron Microscopy Laboratory at the Colorado School of Mines.*