Effect of cooling rate adn ternary additions of chromium on the microstructure of Ti-Si eutectic alloy

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Abstrak

This project investigates the effect of cooling rate and ternary additions of chromium (Cr) on the microstructure of a Ti-Si eutectic alloy. In doing so, three different samples with various composition were prepared, they are: Ti-8.5wt%Si (eutectic), Ti-8.5wt%Si-0.2wt%Cr, and Ti-8.5wt%Si-0.02wt%Cr. During the casting process of each specimen, the molten metal was poured into a wedge-shaped watercooled copper mould so that they have a range of cooling rate along their length.
A calibration curve to determine the cooling rates at different points along the mould was prepared using an Al-6.5wt% Si alloy, for which the relationship between Dendrite Arm Spacing and cooling rate is already known. Observation by using Scanning Electron Microscope (SEM) was also performed in order to observe the change in the lamellar spacing. And in order to relate the change in the lamellar spacing with the mechanical properties, the Ti specimens were subjected to Ball Indentation Test (BIT).
The result shows that the relationship between the strength and the lamellar spacing in both Ti-Si eutectic and Ti-Si eutectic +0.02wt%Cr samples is a Hall Petch-like relationship, where the strength of the material increases with a decrease in lamellar spacing. However, the strength of these two specimens reaches its critical value when the lamellar spacing is about 240 nm. Further from this point, the strength decreases as the lamellar spacing becomes smaller.
The result also shows that the dependency of strength on the lamellar spacing in Ti-Si+0.2wt%Cr is different with the other two samples in a way that there is a continual softening as the lamellar spacing becomes smaller. At this stage, the reason for this is still unknown, therefore, further investigation under TEM is required to observe the deformation mechanism in this particular sample.