

https://dspace.org/

Characterisation of Al-Ti-B grain refiners prepared by aluminothermic reduction of TiO2 and B2O3

Mwamba, Ilunga Alain

2006-11-14T11:26:37Z
http://hdl.handle.net/10539/1687

Downloaded from a DSpace repository. https://dspace.org/

ABSTRACT

Microstructural characterisation was performed on Al-Ti-B grain refiners of different compositions prepared by aluminothermic reduction of TiO_2 and B_2O_3 and dilution of the products in aluminium melts. The microstructure of the grain refiners showed needle-like $TiAl_3$ particles as well as prismatic TiB_2 particles. The TiB_2 particles were coarser than those in conventional Al-Ti-B grain refiners. The microstructure also showed silicon particles and, in some cases, titanium carbide particles (TiC).

The experimental grain refiners were subjected to rolling and reduced in thickness by 20, 40, 60 and 80%. The rolled samples were then heated at 625°C for 4 hours and allowed to cool slowly in the furnace. Significant changes in microstructure were noticed at 80% reduction. The flake-like and needle-like aluminide particles in the as cast microstructure were fragmented and aligned in the aluminium matrix, giving rise to short needle-like particles in parallel rows. These aluminide particles had rough edges which were rounded by heat treatment. The TiB_2 particles were not affected in size or morphology by either the rolling or the heat treatment.

The grain refining performance of the as cast materials was assessed. It was found that the experimental grain refiners had poorer performance than commercial grain refiners. The influence of mechanical and thermal treatments on the grain refining performance of the experimental Al-Ti-B grain refiners was also assessed. Cold working of the grain refiners had a positive influence on the grain refining performance promoting finer grain. Heat treatment of grain refiners after cold working was deleterious and led to a loss of grain refining capacity.

The size and size distribution of TiB_2 particles were determined related to grain refining performance and compared to theoretical models. A relationship was established between the size distribution of the TiB_2 particles in the grain refiners and the grain size of inoculated aluminium. Grain refinement increased with decreasing proportion of coarse TiB_2 particles in the grain refiners. This corresponded to a decrease in Ti and B contents and an increase in the Ti/B ratio.