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Influence of welding speed and grain refinement on grain morphology in Aluminium GTA weld metal

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Master alloys containing aluminium and specifically selected amounts of titanium and boron are normally used as inoculants in aluminium castings to achieve a refined microstructure in the cast ingot. Advantages of grain refinement are for instance less porosity, enhanced mechanical properties such as strength and ductility and a higher resistance to the formation of solidification cracks. The principle of grain refinement by inoculation can also be used in arc welds through adding pieces of such a master alloy to the filler metal. In this way it is possible to enhance the mechanical properties of the weld metal and the weldability of the alloy. The effect of this addition on the GTA weld metal grain structure was analysed in this study for the aluminium alloys 1050A, 5083 and 6082. For this purpose, a filler metal consisting of the base metal and different amounts of the master alloy Al Ti5B1 was produced. The filler metal was then deposited and fused in the base metal in a gas tungsten arc (GTA) welding process. The grain refiner additions led to a significant decrease in the weld metal mean grain size (up to 90%), which was dependent upon base metal and torch speed.

Furthermore, the transition from columnar to equiaxed grain shape (CET) – that is often observed in fusion welds – was investigated closer. An analytical approach was used to describe the influence of base metal, grain refiner content and solidification parameters such as growth rate and thermal gradient (from temperature measurements) on the CET.

Biography

Philipp Schempp (15.01.1983) studied from 2003 to 2009 Mechanical Engineering at the Universities of Stuttgart, Germany and Valencia, Spain (semester abroad). Since 2009 he is a Ph.D. student at BAM – Federal Institute for Materials Research and Testing in Berlin, Germany, working in the division “Welding Technology”.

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