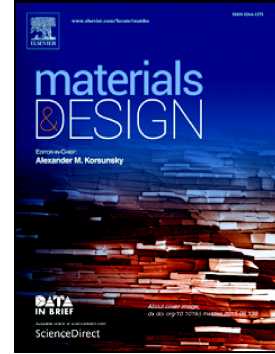


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On the microstructural refinement in commercial purity Al and Al-10wt.% Cu alloy under ultrasonication during solidification

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Abstract:

Physical grain refinement is examined under high-intensity ultrasonication during solidification in commercial purity Al (CP-Al) and binary Al-10wt.% Cu alloy melts cooled naturally in air and compared against chemical inoculation using Al-5Ti-1B grain refiner. The coarse dendritic unrefined base microstructure was completely replaced with a fine equiaxed grain structure in the case of either inoculation or ultrasonication. However, ultrasonication produced more effective refinement over chemical inoculation with a two-fold and eight-fold increase in the grain density in CP-Al and Al-10%Cu alloy, respectively. While combining chemical inoculation with ultrasonication produced the finest grain structure in CP-Al, no further improvement over ultrasonication was noted for the Al-10%Cu alloy. Noticeable reduction in nucleation undercooling, of similar magnitude to chemical inoculation, was observed under ultrasonication. Cooling curve observations indicate strongly enhanced heterogeneous nucleation under ultrasonication. It appears that although chemical inoculation utilises higher potency nucleants, more nucleation events are favoured under cavitation.

Keywords: Grain refining; Ultrasound; Cavitation; Al-Ti-B refiner; Aluminium alloys; Solidification microstructure

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