

Abstract

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Whisker Formation in Porosity in Al Alloys

Examination of the fracture surfaces of tensile test bars from castings held in the liquid state for up to 20 minutes revealed porosity which in some cases contained whisker-like features. Energy Dispersive X-ray analysis in an SEM suggested these might be oxide whiskers forming in an oxide-related pore, entrainment defect. Such entrainment defects (also known as bifilms) may entrap a small amount of the local atmosphere when they form and become incorporated into the liquid metal. This atmosphere may be predominantly air, which then subsequently reacts with the surrounding melt, firstly by the consumption of oxygen, and secondly by the consumption of nitrogen. A CFD model of the heat distribution associated with these reactions between the interior atmosphere of a double oxide film defect and the surrounding liquid alloy suggested that highly localized increases in temperature, up to about 2000 to 5000 K, (2273 to 5273°C), could occur, over a scale of a few hundred μm . Such localized increases in temperature might lead to the oxide within the pore evaporating disassociating, followed by condensation, to form the whisker structures observed. Hydrogen might also be expected to diffuse into the bifilm, and may play a role in the chemical reactions associated with the development of the bifilm.