

8th International Conference on Physical and Numerical Simulation of Materials Processing (ICPNS)

14–17 October 2016

Seattle, Washington | Hosted by Purdue University

SESSION 2: SOLIDIFICATION AND CASTING, SALON B

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SATURDAY, OCTOBER 15, 2016

Improving mechanical performances of γ -TiAl alloys by electromagnetic cold crucible directional solidification technology

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ABSTRACT

Due to their excellent properties such as light weight, high modulus and high temperature strength as well as good oxidation resistance, γ -TiAl based alloys are supposed to be ideal material for application in the aerospace and power-generation industries. However, their ambient brittleness is confining the further application. Recently, in order to overcome these disadvantages, our group has conducted a lot of research work by electromagnetic cold crucible directional solidification (ECCDS) technology for preparation γ -TiAl alloy ingots with directional growth structure. By this approach, TiAl ingots with controllable lamellar structures and less impurity contaminations are obtained. Typically, Ti-47Al-2Cr-2Nb DS-samples exhibit good combination of mechanical properties at room temperature in TS of 650MPa and EL of 3%; with the lamellar orientation perpendicular to the loading stress, the fracture toughness of DS Ti-45Al-2Cr-2Nb samples can reach 24.24 MPa·m^{1/2}. In addition, the rare earth element Er has been added into γ -TiAl based alloys to decrease the oxygen content dissolved in TiAl matrix, and with 0.2 at.% Er addition, the ambient compressive property of Ti-47Al-2Cr-2Nb has improved into 1600 MPa and 43%.

KEYWORDS: TiAl alloy, directional solidification, fracture toughness, compressive properties