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Effects of Pulsed Magnetic Field on Microsegregation of Solute Elements in a Ni-based Single Crystal Superalloy

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The effects of a pulsed magnetic field (PMF) on the microsegregation of solute elements during directional solidification of a Ni-based single crystal superalloy were experimentally investigated, and the results show that the PMF significantly affects the microsegregation of Al, Ti, Co, Mo and W elements in the alloy. However, the distribution behavior differs for both positive and negative segregation elements. With the PMF, the microsegregation of negative segregation elements, Co and W, was restrained effectively, while that of positive segregation elements, Al, Ti and Mo, was aggravated. A segregation model was established to reveal the distribution mechanism of the elements with PMF. It is considered that, under the action of PMF, the jumping of solute atoms from the liquid phase to solid phase are hindered but the jumping of solute atoms from the solid phase into liquid phase are promoted during solidification. As a result, the effective distribution coefficient of the solute atoms are reduced, which leads to the reduction of microsegregation of negative segregation elements and aggravation of microsegregation of positive segregation elements.

Key words: Pulsed magnetic field; Segregation; Superalloy; Distribution coefficient

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