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Directional Recrystallization by Zone Annealing in a Ni-based ODS Superalloy

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Abstract

For new Ni-base ODS superalloy manufactured by mechanical alloying, zone annealing experiment was implemented with parameters of temperature and hot zone velocity in order to develop the directionally recrystallized columnar grains. The progressive growth front of the columnar grains is synchronized with the hot zone movement, and columnar grains in millimeter scale were accomplished by appropriate hot zone velocity. This is secondary recrystallization through preferentially abnormal grain growth of the primarily recrystallized grains with the texture of cube orientation (001)[$0\bar{1}0$] as well as Goss orientation (110)[001]. The growth rate of the columnar grains estimated by using the grain boundary energy (ΔG_{gb}) of the primarily recrystallized grains, pinning force by oxide particles (ΔG_{pin}) and mobility of the grain boundary is relatively comparable to the hot zone velocity. The steep temperature gradient ahead of hot zone is substantially critical to keep the small size of the primarily recrystallized grains that lead to higher driving force for columnar grain growth due to the large grain boundary stored energy.

Keywords: Nickel alloy; ODS; Zone annealing; Temperature gradient; Recrystallization