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Constitutive behavior of $\text{Al}_2\text{O}_{3\text{np}}$ /Al7075 composites with a high solid fraction for thixoforming

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ABSTRACT

The thixotropic compression tests of nano- Al_2O_3 ($\text{Al}_2\text{O}_{3\text{np}}$) /Al7075 composites with different particle sizes and contents and containing a high fraction of solid, were conducted under conditions of 560-590 °C and 0.01-5 s^{-1} , and the microstructures were observed. A visco-plastic constitutive model of nanoparticle reinforced composites for thixoforming was proposed, considering the coupling effects of strain, strain rate, deformation temperature and liquid fraction and presence of nanoparticles, to describe constitutive behavior of the composites under various deformation conditions. Furthermore, the influence of deformation parameters on thixoforming was investigated. It could be shown that the predictions by the developed model were consistent with experimental results. Fracture analysis of the thixotropic compression samples revealed that high deformation temperature or/and high strain rate could prompt continuous uniform distribution of the liquid phase along the grain boundary, causing the formation of a thin liquid film around an approximately spherical grain, accordingly improving thixoformability of the

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