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均匀化后冷却方式对7050铝合金热压缩流变行为的影响

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摘要: 利用Gleeble-1500热模拟机在变形温度为300-450 °C、应变速率为0.001-1.0 s⁻¹的条件下, 对均匀化后经快速水冷和慢速随炉冷却这2种不同冷却方式的7050铝合金样品进行高温等温压缩实验, 研究该合金的热压缩变形流变行为。结果表明: 合金流变应力不仅随变形温度的降低和应变速率的升高而增加, 而且随均匀化后淬火冷却速度的增加而显著升高; 均匀化后水淬样品中合金元素过饱和固溶于基体内, 变形过程中第二相析出并明显粗化; 快速水冷样品的热形变表观激活能为224.9 kJ/mol, 而慢速随炉冷却样品的热形变表观激活能为144.6 kJ/mol; 热压缩变形流变应力的差别随形变温度的升高而降低; 在高温低应变速率下, 应力—应变曲线出现锯齿形波动, 呈不连续动态再结晶特征; 7050铝合金高温塑性变形时的流变行为可用包含Arrhenius项参数Z的双曲正弦函数描述。

关键字: 7050铝合金; 热压缩变形; Zener-Hollomon参数; 变形激活能

Effects of cooling modes on hot compression deformation behavior of aluminum alloy 7050 after homogenization

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Abstract: The flow stress of aluminum alloy 7050 was studied by isothermal compression in 300-450 °C and in strain rate range of 0.001-1 s⁻¹ on Gleeble-1500 thermal-mechanical simulator. Two different cooling modes, i.e. water-quenching and furnace-cooling, were adopted after homogenization of aluminum alloy 7050. The results show that the flow stress of aluminum alloy 7050 increases not only with the decrease of deformation temperature and increase of strain rate, but also remarkably with the increase of cooling rate after homogenization. The alloy elements supersaturate in the matrix of the specimen from water-quenching after homogenization, then the second phases precipitate and remarkably coalesce during the deformation. The apparent activation energy of hot compression of 224.9 kJ/mol is for the sample from the water-quenching, while 144.6 kJ/mol for that from the furnace-cooling. With the increase of deformation temperature, the flow stress difference from the two cooling modes decreases. At higher temperature with slower strain rate, the zigzag curve of the flow stress reveals the discontinuous dynamic recrystallization. The flow stress of aluminum alloy 7050 during hot compression deformation can be expressed by hyperbolic sine equation including Arrhenius term.

Key words: aluminum alloy 7050; hot compression deformation; Zener-Hollomon parameter; deformation apparent activation

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