

Effect of cold rolling and annealing temperature on the recrystallization and mechanical properties of Al-4.7Zn-1.8Mg (wt. %) alloy fabricated by squeeze casting

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Deskripsi Lengkap: <https://lib.ui.ac.id/detail?id=9999920531176&lokasi=lokal>

Abstrak

Aluminium alloys are developed as airplane body due to their lighter weight compared to steel and good formability. Aluminium 7XXX series with Zn and Mg alloying elements is commonly used because its mechanical properties can be improved through a deformation process. A deformation process such as cold rolling may increase the hardness of an alloy through strain hardening. An annealing process following the deformation process will recover ductility through stress relief, recrystallization, and grain growth mechanisms. This research aimed to discover the effect of cold rolling and annealing temperature on the recrystallization and mechanical properties of Al-4.7Zn-1.8Mg (wt. %) alloy. The alloy was produced by a squeeze casting process. Homogenization was conducted at 400°C for 4 hours followed by cold rolling with degrees of deformation of 5%, 10%, and 20%. The samples with 20% deformation were then annealed at 300°C, 400°C, and 500°C for 2 h. The Vickers hardness test was performed on the cold-rolled and annealed samples to reveal the strain hardening effect and subsequent recrystallization process. The microstructure was observed using an optical microscope and a Scanning Electron Microscope (SEM). The results showed that the higher the deformation, the more elongated the grains. Deformation of 5, 10 and 20% led to grain shape ratios of 2.19, 3.19 and 4.59, respectively and increase in the hardness of the alloy from 69.5 VHN to 95.3, 100.1 and 105.4 VHN, respectively. Slip bands and cross slips were found only in the 20% deformed samples. The annealing process resulted in recovery at 300°C, followed by recrystallization at 400°C (d_{grain} ~290 nm) and grain growth at 500°C (d_{grain} ~434 nm). Annealing temperatures of 300°C, 400°C and 500°C decreased the hardness of the alloy from 105.4 VHN to 71.5, 96.8 and 95.3 VHN, respectively.