Mechanical Alloying: A Way How to Improve Properties of Aluminium Alloys

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The Al-10Si-21Fe and Al-20Si-16Fe (wt.%) alloys were prepared by short-term mechanical alloying and subsequently compacted by spark plasma sintering. Prepared samples were characterized by ultrafine-grained microstructure with average dimensions of each structural component that does not exceed 200 nm. This resulted in excellent mechancial properties e.q. hardness and compressive strength. Hardness of both prepared alloys reached almost 400 HV5 and remained the same value even after 100 hour of long-term annealing at 400 °C. The Al-10Si-21Fe alloy reached ultra-high compressive strength of 1033 MPa. The casting Al-12Si-1Cu-1Mg-1Ni alloy, generally considered as thermally stable, was used as a reference material. Even the reference materail was thermally treated by the T6 regime, it exhibitted lower mechanical properties compared to the investigated alloys event at laboratory temperature. During annealing, the reference alloy significantly softened reducing its initial compressive yield strength and compressive strength from 430 MPa and 680 MPa to 180 and 498 MPa, respectively. Additionally, hardness reduction by 50 % to the resulting 63 HV5 was observed. Compared to this results, the investigated alloys maintained theirs high initial hardness and compressive strength suggesting excellent thermal stability.

Keywords: Aluminium alloys, mechanical alloying, spark plasma sintering, mechanical properties, thermal stability.

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