J Material Sci Eng 2018, Volume 7
DOI: 10.4172/2169-0022-C8-114

19th World Congress on

Materials Science and Engineering

June 11-13, 2018 | Barcelona, Spain

Evolution of A201 alloys microstructure during thermal treatment: influence of Si, Ti and B

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Different metastable phases formed during thermal treatment of Al-Cu alloys were investigated by combination of HRTEM, TEM+EDS and HRSEM techniques. The based Al - 4.97 wt. % Cu - 0.56 wt. % Ag alloy (A201) was modified by different additions of Si, Ti and B. Microstructure and mechanical properties were studied in the as-cast, solution treated (at 550˚C for ~20 hours) and aged (at 170˚C up to 32 days) conditions. The precipitation sequence during aging was the following: supersaturated solid solution (SSSS) → GP zones → θ'' → θ' + Ω → θ. During the early stages of aging GP zones are nucleated as single layers of Cu parallel to {100} planes of the →-Al matrix. Then these GP zones are united and generate the metastable θ''-$CuAl_3$ phase consisting of several single atomic layers of Cu, each of them separated by three atomic layers of Al. The Ag, Ti and B additions resulted in nucleation of metastable semi-coherent θ phase formed at {111} α -Al planes. The Si addition increased nucleation of GP zones and inhibited Ω phase. The following aging resulted in θ'' transformation to semi-coherent metastable θ'-$CuAl_2$. The mechanism of this transformation is discussed. The next step of microstructure evolution is diffusional dissolution of θ'' precipitates in the presence of more stable θ' and Ω phases. The maximum microhardness corresponded to simultaneous formation of semi-coherent θ' and Ω precipitates. After extended aging, the θ' transforms to stable incoherent BCT θ-phase.

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