Nanocomposites and nanomaterials

Nanocomposite particles in friction-stir welded Al-Li-Cu-Sc-Zr (1460) alloy

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Structure of Al-2.3%Li-3%Cu-0.1%Sc-0.1%Zr (1460) were studied after FSW on thin cold-rolled sheets with the thickness of 2mm. Sheets were aged in the T8 mode. During FSW, severe plastic deformation and material flow occurs at the temperature lower than melting temperature. Welding was performed at the tool rotation speed 2880 rps. The tool was moved along the weld joint at the constant speed 16 m/h.

Nano-dispersed T_1-phase and nano-composite δ'/θ', $\delta'/Al_3(Sc,Zr)$ particles were present in the base metal zone. There were only δ' and $\delta'/Al_3(Sc,Zr)$ nano-composite phases present in the stirred zone.

The dark-field TEM image of the $\delta'/Al_3(Sc,Zr)$ composite particle obtained from super-lattice reflection has dark shell and transparent core. Transparence is caused to Li dissolution in the $Al_3(Sc,Zr)$ core. Composition analysis of such transparent particles was carried out by TEM image calculation techniques using two-beam kinematical theory of electron diffraction [1]. Li content in $Al_3(Sc,Zr)$ core was estimated to be quite equal ~8-10at.%. These particles are found to be stable for short periods at ~450°C.

The transparent contrast from composite particles disappears after consequent artificial aging of this alloy at temperatures up to 450°C for extended period. Al_3Li phase shell of composite particle dissolves, and one can observe $Al_3(Sc,Zr)$ particle with a pore in its center. This phenomenon can be a consequence of the particle oversaturation by vacancies due to the lithium diffusion from $Al_3(Sc,Zr)$ core to the matrix.

1. *F.W.Gale and B.Vandersande.* // Acta metal.- 1989, - **37**, N 4, -P. 1033-1046.