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Nanocrystalline Al-Mg with extreme strength due to grain boundary doping

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Nanocrystalline Al-Mg alloys are used to isolate the effect of grain boundary doping on the strength of nanostructured metals. Mg is added during mechanical milling, followed by low homologous temperature annealing treatments to induce segregation without grain growth. Nanocrystalline Al-7 at.% Mg that is annealed for 1 h at 200 °C is the strongest alloy fabricated, with a hardness of 4.56 GPa or approximately three times that of pure nanocrystalline Al. Micropillar compression experiments indicate a yield strength of 865 MPa and a specific strength of 329 kN·m/kg, making this one of the strongest lightweight metals reported to date.

Keywords: Grain boundary strengthening; Grain boundary doping; Nanocrystalline metals; Nanoindentation; Mechanical behavior

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