Selection of grain-boundary segregation elements for achieving stable and strong nanocrystalline Mg

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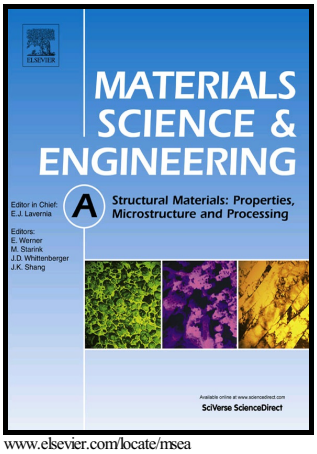

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ABSTRACT: Nanocrystalline metals, e.g., Mg, are often strong but with a low thermal stability. In this study, six solute elements, Ti, Zr, Ta, Co, Cr, La, which are immiscible in Mg under equilibrium conditions, are mechanically alloyed with Mg to study the extension of solid solubility, the thermal stability and the mechanical properties of nanocrystalline Mg. Extended solid solubility of Ti and Zr solutes in Mg matrix is achieved after mechanical alloying. The nanocrystalline Mg is largely stabilized by Ti, moderately stabilized by Zr, and not stabilized by Ta, Co, Cr and La. The onset temperature for a rapid grain growth increases from 100 ^{o}C (0.4 T_m) for nanocrystalline Mg to ~ 350 ^{o}C (0.68 T_m) for nanocrystalline $Mg_{0.95}Ti_{0.05}$ (defined as Mg-5Ti). A relatively small grain size of ~ 145 nm is achieved in Mg-5Ti at 350 ^{o}C. The enhanced