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Effect of interfacial segregation on the interaction between dislocations and precipitates in Mg alloys

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Precipitation hardening has been proven to be one of the most effective strategies to enhance the mechanical properties in many metals. In magnesium alloys, however, the presence of particles only leads to moderate strengthening, almost 5 times less than in the high-strength age-hardenable aluminum alloys. Exploring the interaction between dislocations and precipitates can provide the possibility to regulate the strengthening capability of particles in magnesium alloys.

The mechanism of interaction between precipitates and dislocations was investigated in Mg-Al, Mg-Al-Zn and Mg-Al-Ag alloys using an experimental micromechanical approach consisting of micropillar compression combined with analytical transmission electron microscopy. The interfacial structure of precipitates in the three alloys is first characterized at the atomic scale. The effect of interfacial segregation of Zn and Ag elements on the interaction mechanism between dislocations and precipitates is then investigated. It will be shown that interfacial segregation does not change the type of dislocation-particle interaction mechanism, but that it indeed influences the strengthening potential of particles. These results will be related to the coherency of the particle-matrix interface and the particle size, and they will be framed within the existing knowledge on particle strengthening in magnesium alloys.

Keywords: Magnesium, Precipitation hardening, Interfacial segregation, Dislocation-particle interaction.