INTRINSIC ROOM TEMPERATURE DUCTILISATION OF LEAN RARE-EARTH FREE TERNARY MG ALLOYS

Wassilios Delis, Institut für Metallkunde und Metallphysik, RWTH Aachen, Germany
Pia C. Huckfeldt, Institut für Metallkunde und Metallphysik, RWTH Aachen, Germany
Bengt Hallstedt, Institute for Materials Applications in Mechanical Engineering, RWTH Aachen, Germany
Pei-Ling Sun, Institut für Metallkunde und Metallphysik, RWTH Aachen, Germany
Dierk Raabe, Max-Planck Institut für Eisenforschung, Max-Planck-Straße 1, D-40237 Düsseldorf, Germany
Sandra Korte-Kerzel, Institut für Metallkunde und Metallphysik, RWTH Aachen, Germany
Stefanie Sandlöbes-Haut, Institut für Metallkunde und Metallphysik, RWTH Aachen, Germany

Mg is a lightweight structural material with a good specific strength. Unfortunately, it lacks good room temperature formability and therefore a wider commercial use of Mg is hindered. The preferred basal slip and strong basal-type texture were found to be the main reasons for the poor room temperature formability. For basal slip the von Mises' criterion is not fulfilled and only two independent deformation modes are available for a shape change instead of the needed five independent deformation modes for an arbitrary shape change. Experimental and simulative studies tried to manipulate the alloy system to activate more slip systems without changing strength and work hardening properties. Alloys containing Y and rare-earth elements showed a highly increased room-temperature ductility. However, the aim is to replace Y and rare earth elements by less costly elements. We therefore concentrate on the Mg-Al-Ca system that was suggested by ab initio calculations to have similar properties than Mg alloys containing Y and / or rare earth elements. In experiments, the system indeed showed an increased room temperature ductility. To investigate the specific effects of both alloying elements together and individually, the amount of Ca and Al addition was systematically varied. Mechanical testing, texture and microstructure analysis as well as slip trace analysis give first insights how Ca and Al influence the properties of Mg. Based on these investigations in-depth analysis using micropillar compression of different crystal orientations and TEM analysis was performed. Based on these experiments, the effects of the chemical composition on the ductilisation of this alloy are discussed.