ELECTROPLASTIC DEFORMATION STUDIES OF AN AL-CU EUTECTIC ALLOY USING NANOINDENTATION

Doreen Andre, Institute of Physical Metallurgy and Metal Physics, Germany
andre@imm.rwth-aachen.de
Stefanie Sandlöbes, Institute of Physical Metallurgy and Metal Physics, Germany
Sandra Korte-Kerzel, Institute of Physical Metallurgy and Metal Physics, Germany

A promising approach to deform various groups of materials with poor deformability, such as metallic-intermetallic composite materials, is the exploitation of the electroplastic effect, which lowers the yield strength and enhances the elongation to fracture. However, its underlying metal physical phaenomena are not well understood yet.

Since any experimental attempts to further understand the effect have been limited to the macroscopic scale so far, we developed an in-situ electro-nanomechanical testing setup which enables us to apply electric current pulses during indentation. This allows us to electroplastically deform single crystalline phases of defined orientation. Additionally, due to the microscopic contact area, high current densities can be achieved with this setup.

Here, we present our experimental setup as well as recent results on the deformation of the eutectic Al-Al_2Cu system as well as on the single crystalline Al_2Cu phase. These results reveal displacement shifts upon pulsing, with a larger displacement shift following on the first current pulse, indicating that depinning of dislocations from obstacles is the underlying mechanism. Furthermore, a change in shift direction during unloading was observed which is assumed to be caused by long-range internal stress fields present in the deformed microstructure.