Virtual Material Development for High Power Durable Metallisations (HOME)

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The HOME project is funded by the BMBF (Bundesministerium für Bildung und Forschung) and is executed in cooperation with the EPCOS AG, the Eberl GmbH, the Bundeswehr University Munich, and the Fraunhofer Institute for Mechanics of Materials (IWM) in Freiburg. The objective of HOME is to develop a power durable metallisation for Surface Acoustic Wave (SAW) filters, resistant to high stresses at ultra-high frequencies with a high electric conductivity. The applied methods used bridge the entire range from ab initio modeling to testing. The aim is to understand the mechanisms leading to fatigue and failure, to find physical explanations for a lifetime model and to predict the lifetime depending on the input data like input power and temperature.

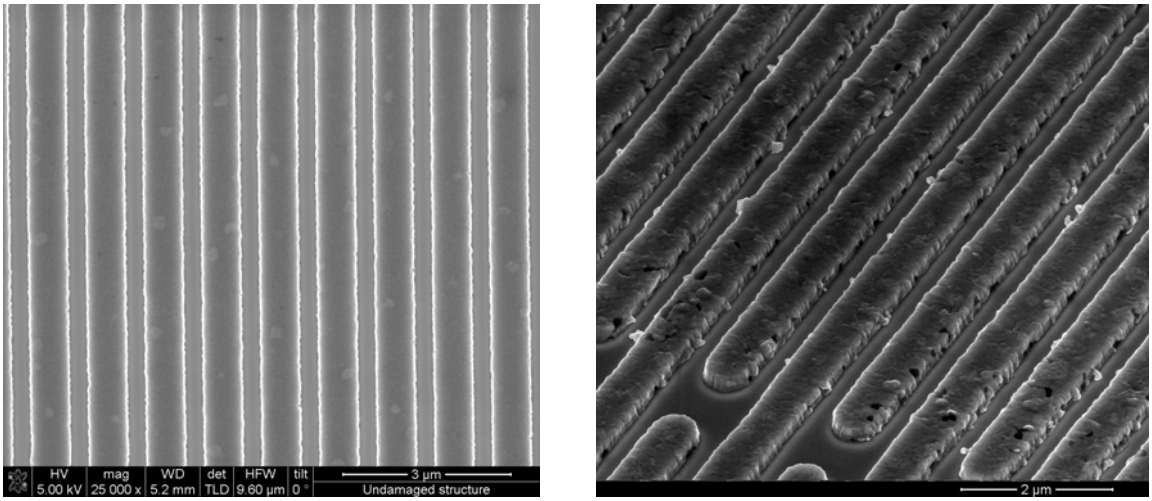
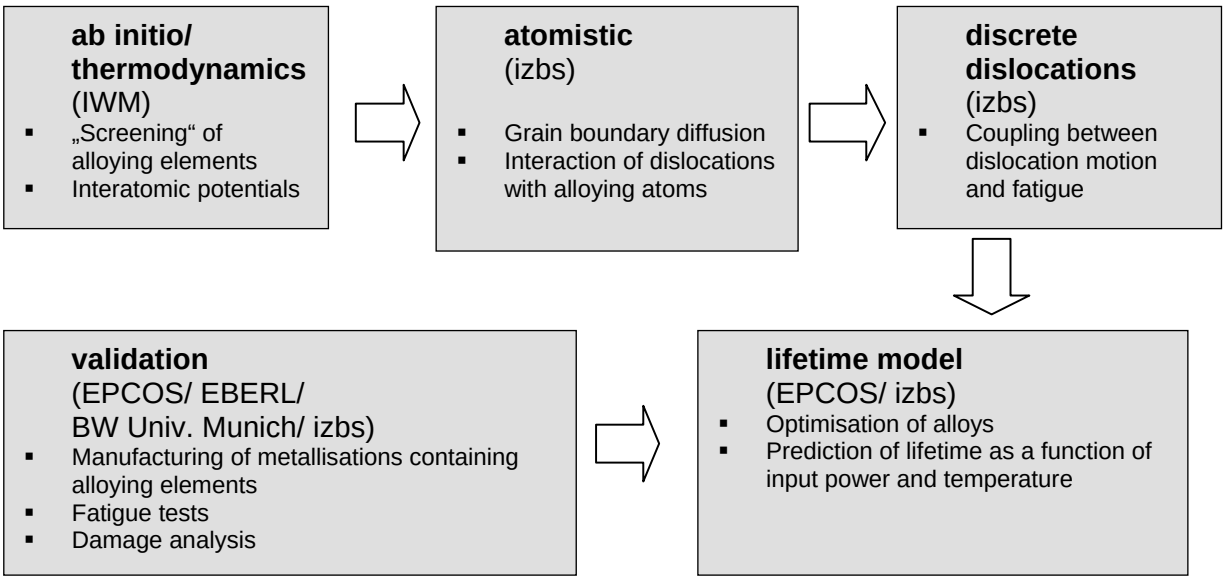


Fig. 1: Undamaged and damaged structure

The project is divided into different work packages, representing the different length scales. The following scheme gives an idea of the structure of the cooperation.



The izbs is involved in the following work packages:

Atomistic (Univ. Karlsruhe)
Dislocation mobilities in pure Al and Al/Cu alloys are studied using molecular dynamics simulations. The interaction between dislocations with grain boundaries and different alloying elements is analysed. Suggestions for useful alloying elements are one of the main goals of this work.

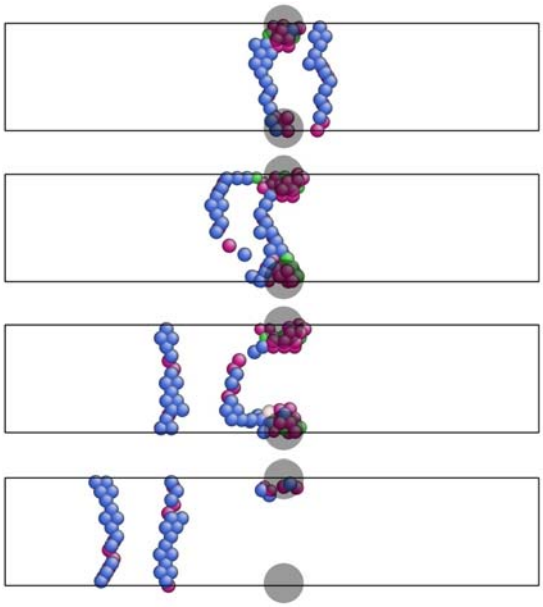


Fig. 2: Interaction of a moving dislocation in Al with a Cu- cluster (grey circle)

Discrete dislocations (EPCOS/Univ. Karlsruhe)
Part of the investigation treats the question whether or not it is possible for dislocations to move at ultra-high frequencies. Therefore discrete dislocation simulations are carried out. The coupling between the dislocation motion and the observed fatigue is of particular interest.

Validation (EBERL/Univ. BW München/ Univ. Karlsruhe)
Endurance tests are realised at EPCOS AG. To quantify the damage formation as a function of power and temperature, the data is analysed by means of Scanning Electron Microscopy, Focused Ion Beam Microscopy and Transmission Electron Microscopy. Metallisations with alloying elements based on the results of the other work packages are manufactured and tested in order to confirm the dependences. Therefore a damage analysis is realised on these metallisations.

Lifetime model (EPCOS/Univ. Karlsruhe)
The goal is to give a physical explanation for a lifetime model that allows predicting the lifetime of different metallisations. The input power and the temperature are the most important parameters to consider. Suggestions for new alloys should be made on the basis of the collected results.