

Fall 10-9-2015

Studying fatigue damage evolution at grain boundaries using micro mechanical test methods

Christian Motz

Saarland University, motz@matsci.uni-sb.de

Follow this and additional works at: http://dc.engconfintl.org/nanomechtest_v



Part of the [Materials Science and Engineering Commons](#)

Recommended Citation

Christian Motz, "Studying fatigue damage evolution at grain boundaries using micro mechanical test methods" in "Nanomechanical Testing in Materials Research and Development V", Dr. Marc Legros, CEMES-CNRS, France Eds, ECI Symposium Series, (2015). http://dc.engconfintl.org/nanomechtest_v/61

This Abstract is brought to you for free and open access by the Proceedings at ECI Digital Archives. It has been accepted for inclusion in Nanomechanical Testing in Materials Research and Development V by an authorized administrator of ECI Digital Archives. For more information, please contact franco@bepress.com.

STUDYING FATIGUE DAMAGE EVOLUTION AT GRAIN BOUNDARIES USING MICRO MECHANICAL TEST METHODS

Christian Motz, Saarland University, Germany
motz@matsci.uni-sb.de

Fatigue of materials and components is one of the main reasons that limit their lifetime and impacts sustainability. The ongoing miniaturization in many areas of modern technology, e.g. microelectronics, medical devices etc., requires the knowledge of mechanical properties in small dimensions to guarantee their reliability. The size of typical fatigue dislocation structures, which control the damage evolution, is in the order of micrometers. Hence, reducing the size of parts and components down into this regime raises the question, whether such microstructures can occur or not and how this affects the damage evolution. For this reason, the development of fatigue microstructures and the damage evolution will be studied by in-situ fatigue tests in the scanning electron microscope on single and bi-crystalline micro samples depending on specimen size (0.5 to 15 μm), initial dislocation density and crystal orientation. Modern methods will be utilized to measure not only the microstructure and damage evolution, but also local stresses and strains in the samples. This allows the correlation between microstructure and damage and the local loading of the sample. In the case of grain boundaries incompatibilities in local stresses and strains are of special interest as these are correlated with the damage evolution at the grain boundary by different models in the literature. The main advantage of using micron-sized specimen is the knowledge of the local stresses and strains, which allows to associate changes in the stress vs. strain curves with microstructural events. For example, it is possible to correlate the (local) Bauschinger-effect with the back stress of dislocation pile-ups at grain boundaries. The aim of the presentation is to understand the development of fatigue microstructures in dependence of the specimen size in order to predict the lifetime of miniaturized parts and components. Additionally, it will lead to a better understanding of the role of grain boundaries in fatigue damage evolution and can help to improve current models. In principle, the achieved knowledge can also help to better understand fatigue phenomena at the macro scale.