LOCALLY RESOLVED FRACTURE MECHANISMS BY USING IN-SITU MICROSCOPIC TESTING

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One of the most common reasons for materials failure is the nucleation and propagation of cracks, which makes the detailed understanding of these apparent failure processes a highly important topic from an engineering point of view. The field of fracture mechanics is growing since the 1950s through various theoretical and experimental works, but only the recent implementation of micromechanical testing devices in scanning electron microscopes (SEM), enables the possibility to observe in-situ crack propagation, with sub-micron resolution. The present work focuses on an experimental approach to evaluate crack propagation during micromechanical fracture experiments conducted in-situ in an SEM. Therefore, we utilize a continuous measurement of sample stiffness and crack length from both, experimentally measured force-displacement data as well as SEM images. The main advantage of such a combined method is the possibility of performing detailed analysis of non-linear elastic processes, frequently observed in relevant engineering materials. The current work aims to show challenges and solutions regarding the setup and implementation of such experiments, spanning from brittle model materials such as silicon to highly ductile metals.