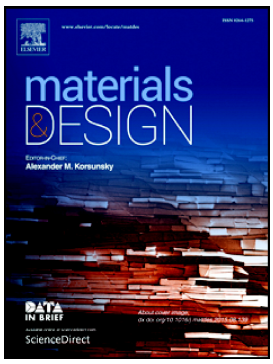
Accepted Manuscript



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PII: S0264-1275(18)30236-3
DOI: doi:10.1016/j.matdes.2018.03.051
Reference: JMADE 3793

To appear in: *Materials & Design*

Received date: 15 February 2018
Revised date: 16 March 2018
Accepted date: 21 March 2018

Please cite this article as: Markus Alfreider, Darjan Kozic, Otmar Kolednik, Daniel Kiener , In-situ elastic-plastic fracture mechanics on the microscale by means of continuous dynamical testing. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Jmade(2017), doi:10.1016/j.matdes.2018.03.051

In-situ elastic-plastic fracture mechanics on the microscale by means of continuous dynamical testing

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Highlights

- Continuous *J-Δa* curves were measured in-situ in a scanning-electron microscope by means of dynamical compliance testing.
- A generalized stiffness to crack length relation for micro cantilever fracture geometries was proposed based on experimental and numerical results.
- A novel method for evaluation of crack growth initiation based on dynamic compliance data was shown.

Abstract

Measuring the local behaviour of a propagating crack in a quantitative manner has always been a challenge in the field of fracture mechanics. In-situ microcantilever testing inside a scanning electron microscope (SEM) is one of the most promising techniques for the investigation thereof. However, quantifying such experiment is fairly challenging. Here, for the first time we utilize a continuous measurement of the dynamic compliance in-situ to permit evaluation of the crack length. Microcantilever experiments have been performed on brittle single crystalline Si and nanocrystalline Fe to assess the stability of the setup, the applicability of the technique inside an SEM and to establish a correlation between stiffness and crack length. Subsequently, micromechanical fracture tests were performed on single crystalline, <001> {001} oriented Tungsten as a model material and continuous *J-Δa* curves were measured. The gathered data was evaluated with close relation to standardized fracture mechanics testing and showed an overall agreement with literature data. This novel possibility to measure *J-Δa* curve behaviour continuously and locally while also following the crack extension