In-situ electrochemical nanoindentation as a promising tool for probing hydrogen-material interaction

Anna Sophie Ebner[1,]*, Helmut Clemens[1], Reinhard Pippan[2], Verena Maier-Kiener[1]

1. Department of Physical Metallurgy and Materials Testing, Montanuniversität Leoben, Austria
2. Erich Schmid Institute of Materials Science, Austrian Academy of Sciences, Leoben, Austria

*anna.ebner@unileoben.ac.at

In technical applications, materials often have to withstand harsh environments. Especially the exposure to hydrogen is a trouble causing issue in chemical industry and for energy storage applications involving hydrogen. Since high strength materials, such as high strength steels or nickel-base alloys, often suffer from significant susceptibility to hydrogen embrittlement, the investigation of mechanical properties under hydrogen influence is a promising field of research to understand the underlying hydrogen embrittlement mechanisms for further material development.

A convenient local characterization method is the electrochemical in-situ nanoindentation. Therefore, this in-operando nanoindentation technique was implemented in a G200 nanoindenter platform to study the nanomechanical characteristics of a nickel-base alloy under hydrogen charged condition. Beside reproducible measurements of standard mechanical properties, like hardness and Young's modulus, deeper insight in the acting deformation processes can be gained by advanced testing methods. With nanoindentation strain-rate jump tests the determination of strain-rate sensitive properties on a local scale is viable. In combination with laser confocal microscopy the plastically deformed