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INTERDISCIPLINARY CENTRE FOR
ADVANCED MATERIALS SIMULATION

Monday, 10th of Januar, 4:30 p.m.
ICAMS Seminar room UHW 11/1102

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How to select a proper metal against hydrogen embrittlement: Probing the hydrogen effect at nanoscale

Despite hydrogen embrittlement has been known for more than a century a clear explanation of the governing mechanism is still missing. This is mainly due to the intrinsic complexities of the experimental examination of hydrogen embrittlement. On the basis of these complexities, an experimental approach, in situ electrochemical nanoindentation, is proposed and performed on different materials. This technique is capable of registering the onset of plasticity in extremely small volumes, namely perfect crystals in hydrogen free and charged conditions. It is shown that hydrogen reduces the required stress for the onset of plasticity due to reduction in the dislocation line energy. This is explained by the Defactant Concept, i.e. reduction of the defect formation energy in the presence of hydrogen. Thus, neither hydrogen enhanced decohesion (HEDE) nor hydrogen enhanced plasticity (HELP), but the reduction in the defect formation energy are responsible for hydrogen embrittlement.

The change in the dislocation line energy measured during nanoindentation can be successfully used to evaluate the intrinsic resistivity of the examined alloy or metal against hydrogen embrittlement. This makes in situ ECNI a versatile technique for development of new hydrogen resistant alloys.