COMBINED *IN SITU* MECHANICAL TESTING AND SCALE-BRIDGING 3D ANALYSIS OF NANOPOROUS GOLD

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In this work we present results on *in situ* small scale testing of nanoporous gold (npg) in scanning electron microscopy (SEM) and transmission electron microscopy (TEM). By combining nano- and micromechanical testing of pillar structures with advanced tomographic imaging, a 3D characterization of the plastic deformation process in different states of deformation is achieved. For small strut sizes 360° electron tomography (ET) is applied enabling high quality reconstructions of the 3D morphology of npg without missing-wedge artefacts. Combining the geometric information with mechanical data from *in situ* testing in SEM and TEM the yield strength is precisely determined. Furthermore, the experimentally derived 3D data are used as input for large-scale molecular dynamics (MD) simulations in order to understand the role of strain localization and identify predominant defect processes.

For larger strut sizes mechanical testing and 3D structure analysis of npg pillars are carried out by *in situ* SEM and high-resolution X-ray tomography (Nano-CT), respectively (cf. Figure 1). Image correlation analysis applied to *in situ* SEM image series reveals the evolution of local strain gradients during deformation and, in particular, local yielding in the very early stages of deformation. The yield strength strongly depends on strut size revealing a clear size effect. The scale-bridging approach is complemented by *in situ* nanomechanical testing of single struts in TEM.

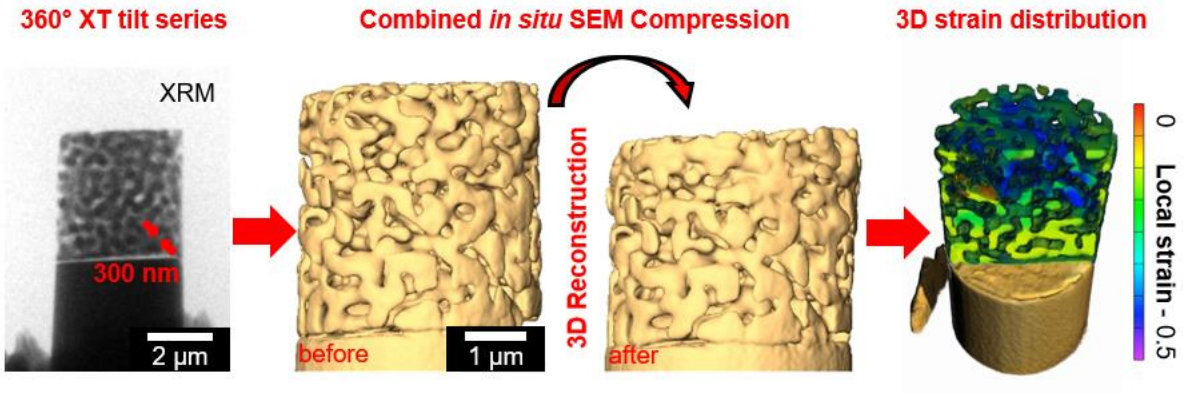

Figure 1 – Scale-bridging 3D analysis of coarser npg pillars by means of in situ SEM nanomechanics and 360° XT revealing the distribution of plastic strain after deformation.

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