ELECTRON BEAM INDUCED SOFTENING OF FUSED SILICA

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High dose electron beam irradiation can induce superplasticity in oxide glasses such as fused silica. A recent study, however, has shown that this behavior affects micromechanical testing inside the scanning electron microscope (SEM) already at moderate electron beam doses. Micro pillar splitting experiments delivered fracture toughness values as high as 1.9 MPa $m^{1/2}$ in case the electron beam was running to monitor the process while similar experiments under ambient conditions delivered values in the range of 0.7 MPa $m^{1/2}$; a value in excellent agreement with data from literature. Nowadays, InSEM tests are widely used in micromechanics, which proves the need for quantification of the effects of electron beam irradiation on test results, using fused silica as model system in the present study.

A micro pillar compression and micro pillar splitting approach was used to study softening and toughening effects of electron beam irradiation. The micro pillar were processed via deep reactive ion etching (DRIE). Upon testing the electron beam dose was varied via changing acceleration voltage and beam intensity inside a commercial SEM. In parallel, a similar study was performed at elevated temperatures up to 1100°C which allows to link electron induced to thermally induced softening and toughening in the fused silica system.