Supplementary Materials

# S1: CCP indentation creep testing on UFG Cu

The load-displacement relationship for CCP tests on Cu applying different contact pressures is shown in Fig. 9a. The contact pressure was varied in six different stages between 1.1 and 1.6 GPa (Fig. 9b). The resulting indentation creep strain rates are plotted in Fig. 8c.

The tests in which a contact pressure of 1.6 GPa was applied show an initial increase in indentation strain rate before it slowly saturates (Fig, 9c). At the same time, the applied contact pressure decreases slightly during the experiment (Fig. 9b). Both effects indicate that the maximum possible contact pressure was reached or even slightly exceeded. As mentioned earlier, the maximum loading rate and thus the maximum contact pressure that can be applied is limited by the speed of the control loops of the indentation device.

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*Figure 9: Indentation CCP tests on Cu. In a) the load vs. displacement, in b) the contact pressure vs. displacement and c) the indentation strain rate vs. time is plotted for a single partial unloading event at the beginning of the CCP test segment.*

# S2: Uniaxial constant stress testing on UFG Cu

The results of the uniaxial constant stress tests on Cu are shown in Fig. 10. In Fig. 10a, the stress strain response of tests with and without partial unloading segments are plotted. The time dependent increase in strain is shown in Fig. 10b, the resulting creep strain rate as a function of test time and total strain is illustrated in Fig. 10c-d.

*C:\Users\Christian Minnert\Desktop\Figures submission 1\Fig. 8\Fig 8_LZW.tifFigure 10: Uniaxial constant stress tests on Cu with partial unloading at the beginning of the creep segment: stress vs. strain (a), strain vs. time (b), strain rate vs. time (c) and strain rate vs. strain (d).*