
A Supplementary Materials

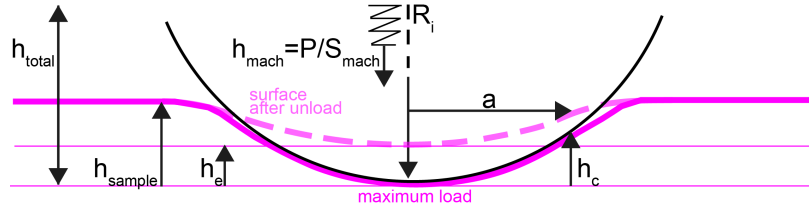


Fig. A.1 Schematic illustration of a spherical indent and the displacement during nanoindentation, adapted after Pathak and Kalidindi [40] and Li et al. [30]. The total measured displacement, h_{total} is the summation of the displacement due to deformation of the sample, h_{total} , and the deflection, h_{mach} , induced by the combined stiffness from the indenter tip and the loading frame, S_{mach} . The plot of contact depth, h_c , calculated according to Equation 11 against the contact area, a , calculated using Equation 14, describes the effective tip shape during spherical nanoindentation.

Table A.1 Summary of results presented in Figure 2. For each nominal radius R_n the Table presents R_{eff} calculated similar to Li et al. [30] using data collected in fused silica (FS), glassy carbon (GC), and sapphire (SPH) and R_{eff} calculated as a function of load as outlined in section 2.2.1. The values presented in the first column represent the slope of the line fit to data calculated as the difference of elastic experiments in silica and sapphire and represent the values used for R_{eff} implemented as a constant.

R_n μm	R_{eff} μm after Li et al. [30]			$R_{eff}(P)$	
	FS - SPH	GC - FS	GC-SPH	R_{eff} μm	P (N)
2	0.3	0.25	0.41	0.76 ± 0.63	$2.5 * 10^{-3}$
5	6.97	6.97	8.4	3.43 ± 0.63	0.07
10	10.36	9.04	10.45	6.6 ± 0.8	0.08
20	23.5	32.3	28.75	18.2 ± 5.8	0.2
50	31.4	46	40	32 ± 4.7	0.25

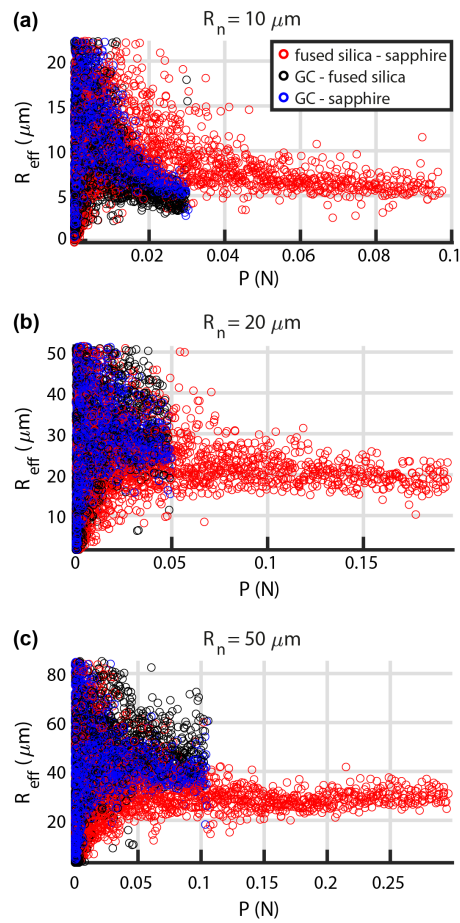


Fig. A.2 Effective radius calculated using the first numerical derivative of data calculated using Equation 8, similar to Figure 1b, for tips with a nominal radius of a) 10 μm , b) 20 μm , and c) 50 μm . The legend indicates that the data has been calculated using the difference in reported displacements at a similar load in two materials with known moduli.

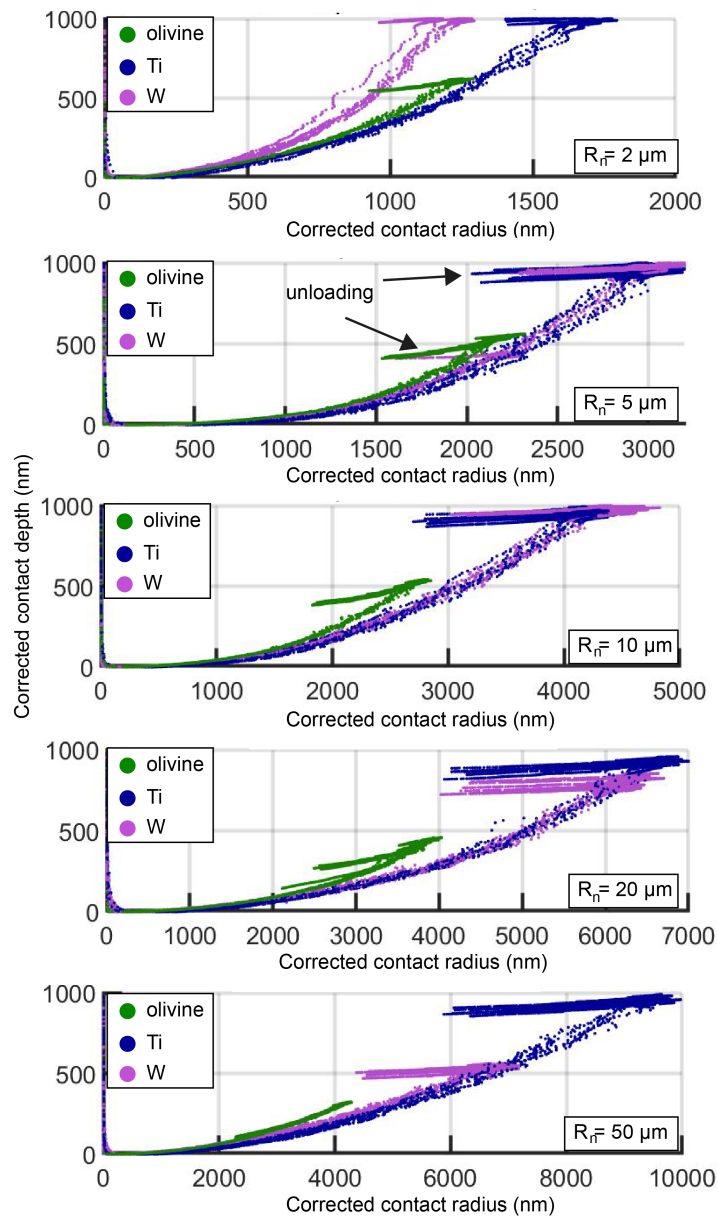


Fig. A.3 Effective tip shape calculated with corrected data in olivine, tungsten, and titanium, with tips with varying radii. Note the differences in the horizontal axis. For largest tip radii, the indent experiments in olivine are purely elastic, whereas the residual imprint increases with decreasing radius, as displayed by the segment corresponding to the unloading.

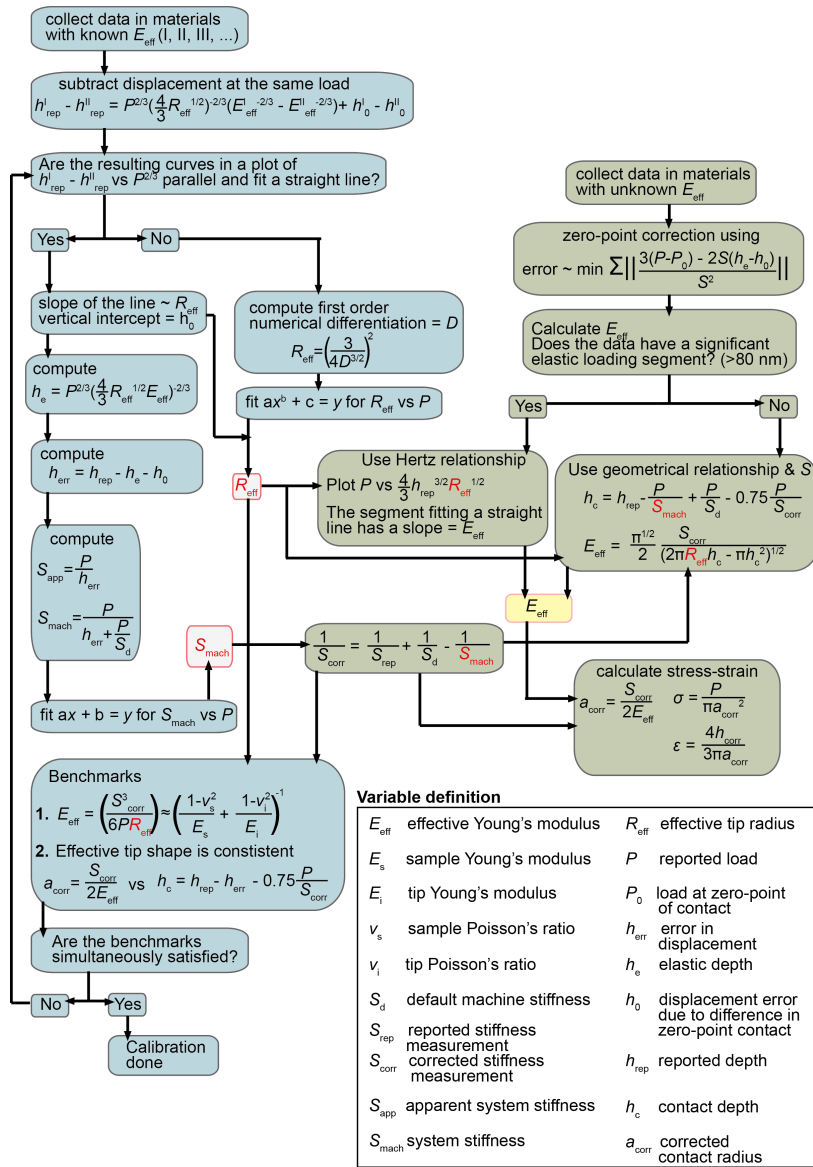


Fig. A.4 Schematic flow-chart diagram summarising Section 2.2 in blue and Section 2.3 in green.

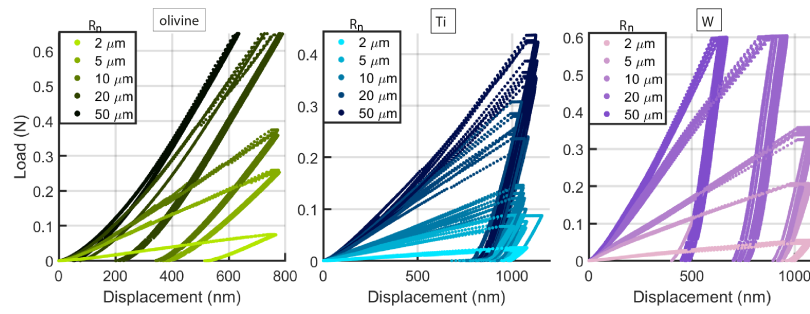


Fig. A.5 Load-displacement curves in olivine, titanium, and tungsten collected during load-controlled experiments with spherical tips with nominal radii ranging 2 – 50 μm .