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Ultra-high residual compressive stress (>2 GPa) in a very small volume (<1 μm^3) of indented quartz

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Abstract

Indentation testing of natural single-crystal α-quartz parallel to the crystallographic *c* axis, using a triangular pyramidal diamond indenter at a maximum load of 500 mN, produced a very small residual volume of less than 1 μm^3 in which α-quartz is highly stressed. Laser Raman microspectroscopy across the indentation at room temperature and pressure revealed a shift in the Raman bands, interpreted to reflect the residual stress field generated within the α-quartz. Based on the observed Raman shift, we identified a steep gradient in the residual non-hydrostatic stress field after complete unloading in quartz near the impression formed by indentation. At the center of the indentation, the maximum compressive stress and tensile stress were inferred to be higher than 2.2 and 0.1 GPa, respectively.

Keywords: Nanoindentation, quartz, Raman spectroscopy, ultra-high residual stress