

Structural phase transition in ZrO₂ induced by swift heavy ion irradiation at high pressure

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Recent experiments have demonstrated unexpected structural changes when exposing pressurized crystals to swift heavy ions [1]. Natural Zirconia (ZrO₂) transforms from the monoclinic structure (at ambient conditions) to its tetragonal (high-temperature) phase if irradiated with swift heavy ions. Without external pressure the required fluence must exceed 5×10^{12} ions/cm² for Pb and U, and even higher fluences are necessary for lighter ions [2]. If samples are pressurized during irradiation using diamond anvil cells (DAC) the required fluence drops at least one order of magnitude. Figure 1 displays the Raman spectra of ZrO₂ samples irradiated with 1.5×10^{11} ions/cm² at different pressures. Samples irradiated at ≥ 11.1 GPa show new Raman bands at 145, 260, 462, and 640 cm⁻¹ which are assigned to the tetragonal phase of ZrO₂. The conversion from the monoclinic to the tetragonal phase becomes more pronounced with increasing pressure.

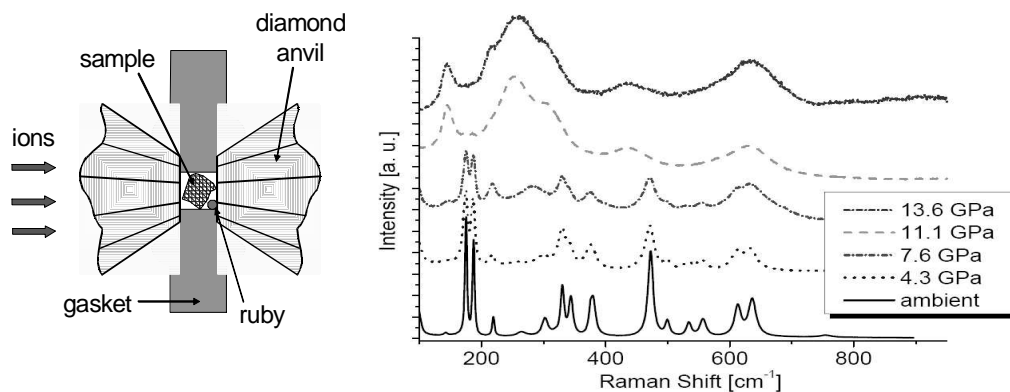


Figure 1. **left:** Schematics of a DAC with pressurized sample. **right:** Raman spectra of ZrO₂ exposed to different pressures and irradiated with 1.5×10^{11} U-ions/cm² (39 MeV/u, $dE/dx \cong 37$ keV/nm). The irradiation was performed at the heavy-ion synchrotron SIS at GSI.

[1] U.A. Glasmacher *et al.*, *Phys. Rev. Lett.* 96 (2006) 195701.

[2] A. Benyagoub *et al.*, *Appl. Phys. Lett.* 77 (2000) 3197.