An Improved Hydrothermal Diamond Anvil Cell

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A new type of HDAC-V hydrothermal diamond anvil cell (HDAC-VT) has been designed to meet the demands of X-ray research including X-Ray Fluorescence (XRF), X-ray Absorption Spectroscopy (XAS), and small angle X-ray scattering (SAXS). The earlier version of HDAC-V that offered a large rectangular solid angle used two posts and two driver screws on both sides of a rectangular body. The new version HDAC-VT in a triangular shape has two alternative guide systems, either three posts inserted into bushings suitable for small anvil faces or linear ball bearings suitable for large anvil faces. The HDAC-VT having three driver screws offers the advantage of greater control and stability even though it sacrifices some of the size of solid angle. The greater control allows better sealing of samples, while greater stability results in longer survival for anvils and ceramic parts. This improved design retains several beneficial features of the original HDAC-V as well. These include the small collar that surrounds the heater and sample chamber forming an Ar + H_2 gas chamber to protect diamonds and their heating parts from being oxidized. Three linear ball bearings, when used, fit to the three posts prevent seizing that can result from deterioration of lubricant at high temperatures. Positioning the posts and bearings outside of the gas chamber as in HDAC-V also prevents seizing and possible deformation due to overheating. In order to control the heating rate precisely with computer software, we used Linkam T95 and replaced the Linkam 1400XY heating stage with the HDAC-VT allowing the HDAC to be heated to 950 ºC at a rate from 0.01 ºC/min to 50 ºC/min. We used the HDAC-VT and Linkam T95 to observe in situ nucleation and growth of zabuyelite in aqueous fluid, and to homogenize melt inclusions in quartz from three porphyry deposits in Shanxi, China.