# *In situ* STUDY OF $C_{60}$ POLYMERISATION UNDER HIGH PRESSURE HIGH TEMPERATURE CONDITIONS

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$C_{60}$ polymerisation was studied *in situ* at High Pressure High Temperature (HPHT) conditions. A special design of the heater for the high pressure diamond anvil cell allowed us to record Raman spectra with a 785 nm laser at non hydrostatic conditions in the pressure range 5–27 GPa and temperatures up to 850 K. At lower pressures we studied in detail the formation of one and two dimensional $C_{60}$ polymers. Only three phases known from previous studies on quenched samples (orthorhombic, tetragonal and rhombohedral) were found. The phase diagram drawn according to our data for pressures below 8 GPa and temperatures up to 800 K is in a good general agreement with the phase diagram for data obtained on quenched samples. X-ray diffraction study on quenched samples as well as *in situ* during the heating was performed at beamline ID30 of European Synchrotron Radiation Facility (ESRF). The study of quenched samples showed amorphisation above 20 GPa. Nevertheless some weak diffraction patterns of $C_{60}$ were found up to 27 GPa.

Special effort was made to study $C_{60}$ polymerisation at HPHT conditions which were reported to produce three-dimensional superhard materials (8–18 GPa, 800–820 K). First an *in situ* X-ray diffraction study was performed at these conditions. The long time of heating (several hours) allowed us to obtain a crystalline phase even for HPHT conditions as high as 13 GPa and 820 K. This phase is interpreted as rhombohedral with a shorter c-axis compared to two dimensional phase. No elliptical Debye-Scherrer diffraction patterns were found in this phase, but increase of the pressure above 13 GPa lead to elliptical shape of diffraction patterns even at room temperature. Therefore, this unusual anisotropic deformation cannot be attributed to three dimentional polymerisation as it was suggested in previous studies.