SYNTHESIS OF ^{13}C DIAMOND PRESSURE MARKER FOR IN-SITU DAC EXPERIMENT

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Introduction: Raman spectrum of ^{13}C diamond has been successfully used for pressure measurement up to 13 GPa in an externally heated diamond-anvil cell (HDAC) [1,2,3]. It has a number of advantages in comparison with other optical pressure sensors. ^{13}C Raman peak is well separated from that of the diamond anvils, doesn't react either with supercritical silicate-saturated H_2O fluids or H_2O-saturated silicate melts over a large range of pressure and temperature of interest [1]. Despite of these advantages, small aggregates of ^{13}C diamond as a pressure marker for HDAC experiment are not readily available. In order to synthesize ^{13}C diamond aggregates suitable for this purpose, we conducted a series of experiments in a Kawai-type multianvil apparatus (USSA-5000).

Experimental: Synthesis of ^{13}C diamonds was made by direct conversion of amorphous 97% pure ^{13}C (99%). ^{13}C powder was loaded directly into MgO capsule and $LaCrO_3$ was used as a heater. At the beginning of each experiment pressure was increased slowly up to 21 GPa, then sample assembly was heated to 2100-2400°C, kept for 3-4 minutes and quenched by shutting off the electric power supply. Among recovered samples only the one synthesized at 2400°C was fully transformed to diamonds with the grain size several micrometers. Raman spectra of this diamond aggregate showed a sharp peak (FWHM about 6.5 cm^{-1}) near 1284.4 cm^{-1} at ambient conditions (Fig. 1).

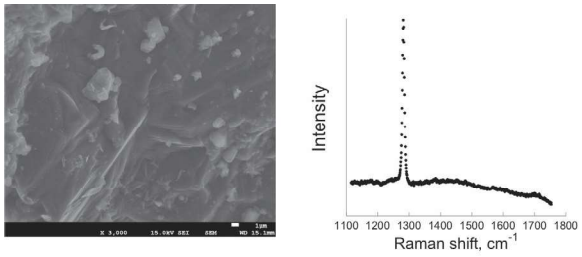

Fig. 1 *SEM image (on the left) and Raman spectrum (on the right) of the synthesized ^{13}C diamond aggregate.*

Results and Discussion: Cross-calibration of the Raman peak of synthesized ^{13}C diamond diamonds with the ruby fluorescence lines and the phase transitions in H_2O system showed a good agreement between these three pressure indicators within the reported uncertainty [1,4,5]. Thus, synthesized ^{13}C diamonds can be used for high-temperature and high-pressure experiments in HDAC and provide an opportunity to monitor pressure with a precision ±0.3 GPa.

References: [1] D. Schiferl, M. Nicol, J. M. Zaug, S. K. Sharma, T. F. Cooney, S.-Y. Wang, T. P. Anthony, J. F. Fleischer, *J. Appl. Phys.* **82**, 3256-3265 (1997). [2] F. Datchi, A. Dewaele, P. Loubeyre, R. Letoullec, Y. Le Godec, B. Canny, *High Press. Res.* **27**, 447 (2007). [3] B. O. Mysen, Sh. Yamashita, *Geochim. Cosmochim. Acta.* **74**, 4577 (2010). [4] C. S. Zha, H. K. Mao, R. J. Hemley, *PNAS* **97**, 13494 (2000). [5] W. Wagner, A. Saul, A. Pruss, *J. Phys. Chem. Ref. Data* **23**, 515 (1994).