ESRF	**Experiment title:** High pressure-high temperature phase diagram of beryllium	**Experiment number**: HS-4214
Beamline: ID27	**Date of experiment**: from: 08/12/2010 to:11/12/2010	**Date of report**:
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Report:

The proposal focused on two pressure domains which can be reached in two different high pressure devices: (1) 50<P<200 GPa, 300<T<5000K, in a laser-heated diamond anvil cell (to look for a possible bcc phase and the melting line of beryllium [1,2]); (2) 0<P<6 GPa, 300<T<2000K, in a Paris-Edinburg press (to better understand the stability range of the enigmatic b-Be, which has been observed directly by only one X-ray diffraction study [3]).

Part (1): Three samples have been studied in a laser-heated diamond anvil cell; the pressure transmitting medium was NaCl and in the run Be_3, MgO was placed close to the sample to provide a better estimate of pressure. We have followed the P-T paths represented Figure 1. No chemical reaction of Be with the pressure medium, MgO or the diamond anvils has been detected. In the studied range, only the α-Be (hcp) phase has been observed; we thus failed in evidencing the β-Be and the ultra-high pressure bcc Be. Around 200 GPa, we could see active recrystallization (appearance/disappearance of single crystal spots every few seconds) of α-Be in the laser-heated spot (temperature between 3300 and 4200K), which suggests that α-Be remains the stable phase in these conditions.

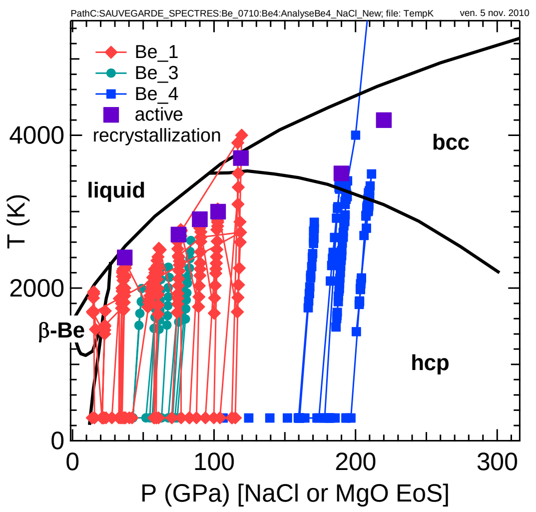

Figure 1: P-T paths followed in our diamond anvil cell experiments. The phase diagram proposed in [2] is represented in black. Temperature has been measured by pyrometry, pressure using NaCl or MgO pressure standards. The purple squares correspond to the conditions at which active recrystallization has been observed. They can be considered as a lower bound for the experimental melting curve.

The observation of active recrystallisation has been used as a diagnostic of melting [4]. Here it has been observed several hundreds of K below the melting curve predicted by theory. We have not been able to observe the X-ray scattered signal of fluid beryllium, even when the theoretical melting line was crossed. We

are planning to check if the pyrometry temperature is compatible with the observation of thermal expansion of the laser-heated sample.
In run Be_3 the equation of state of α-Be has been measured using MgO pressure gauge and pyrometry temperature estimate. The thermal expansion under pressure is compatible with the quasi-harmonic model from Ref. [1].

References :

[1] L. X. Benedict et al., Phys. Rev. B 79, 064106, 2009
[2] G. Robert et al., Phys. Rev. B 82, 104118, 2010
[3] A.J. Martin and A. Moore, J. Less-common Met. 1, 85, 1959
[4] D. Santamaria-Perez et al., J. Chem. Phys. 130, 124509, 2009