ESRF	**Experiment title:** Melting Studies of V at High Pressure using Laser Heated Diamond Anvil Cells and X-ray Diffraction	**Experiment number**: HS 4210
Beamline: ID27	**Date of experiment**: from: 08/09/2010 to: 12/09/2010	**Date of report**: 06/10/2010
Shifts: 12	**Local contact(s)**: A. Salamat, M. Mezouar, G. Garbarino	*Received at ESRF:*

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Report:

Very recently we have been awarded in-house beamtime to gather more data on the melting line of Sn. To permit us access to the guest house and other ESRF facilities the beamtime was scheduled under above mentioned proposal title and number (the actual proposal HS 4210 for V itself did not get beamtime awarded). We managed to collect substantially more melting point data on Sn than before (compare to experimental report HS 3834) and hence are submitting this experimental report to support our new proposals to study MgO (proposal 27914) and the Ta-C system (proposal 27839) under combined conditions of high pressure and high temperature using similar techniques.

Experiments were conducted at ESRF beamline ID27. Double sided laser heating of diamond anvil cell (Sn) samples was employed in conjunction with fast time scale x-ray diffraction and simultaneous thermal emission measurements to monitor the state and temperature of the sample at the centre of the laser heating hot-spot. Experiments at ID27 have shown that this combination of techniques is crucial to minimise temperature gradients at the sample and to be able to distinguish between true melting events and possible reactions of the sample with pressure media or even the diamond anvils themselves.[1] Present experiments were conducted with NaCl and KBr pressure media, KBr was used for the higher pressures as experiments have also shown that a crossover of sample and media melting curves (i.e. if the pressure medium melts before the sample) makes it more difficult to melt the sample / detect melting events.[1] Our results together with some other melting data for Sn are shown in figure 1.

At low pressures our data are in good agreement with multi-anvil melting points recorded in our laboratory in London and two theoretical models[2,3] put forward to describe the melting line of Sn. As pressure increases our data lies slightly above that predicted by the dislocation mediated model[2] and is in good agreement with recent published data[4] obtained by laser heated diamond anvil cell (LHDAC) experiments employing the laser speckle technique to characterise the melting transition. Around 55 GPa both LHDAC data sets agree with the discontinuity in the Hugoniot reported from dynamic high pressure experiments and associated with the melting transition.[5,6] Beyond 60 GPa, however, the LHDAC data obtained by the speckle technique[4] flattens out where as our data continues to show an increase in the melting temperature with increasing pressure. The points at ~70 GPa were obtained with two different pressure media (NaCl vs KBr) but both lie substantially above the melting temperature obtained by the speckle technique. According to the x-ray data obtained in our experiments no reaction of the sample with its surroundings occurred (all peaks can be assigned to the Sn sample and the medium employed). Furthermore, diffuse liquid scattering features can clearly be observed in the recorded intensities. The speckle technique may not be able to distinguish between melting of the sample and reactions of the sample, further underlying the necessity to conduct high pressure melting point experiments in conjunction with synchrotron x-ray scattering.

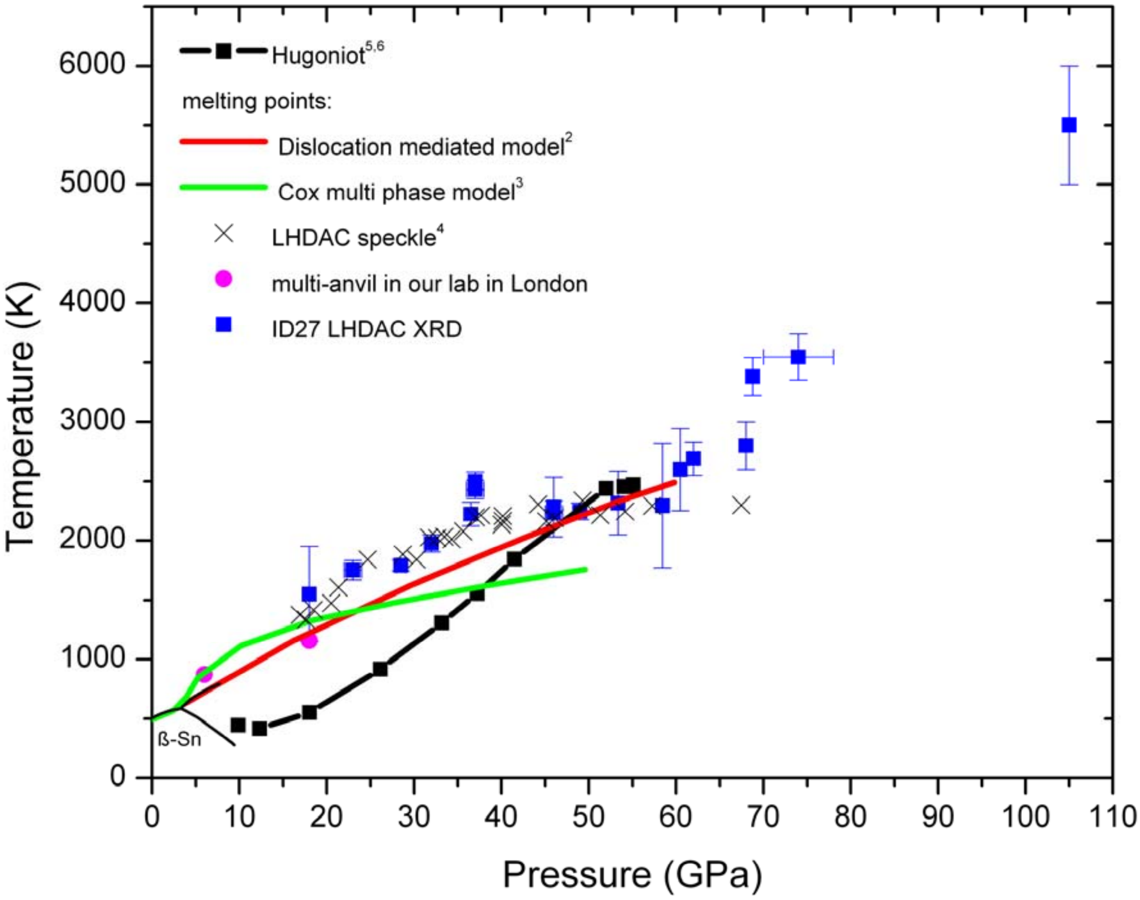

Figure 1: Sn melt line data obtained in our LHDAC experiments conducted at ID27 plotted together with other data sets from LHDAC speckle experiments, multi-anvil experiments, two theoretical models and Hugoniot data from shock experiments.

References:

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2) X. Feng and C. Ling-Cang, *Chinese Physics B* **18**, 2898 (2009).
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4) Schwager *et al.*, *J. Chem. Phys.*, **133**, 084501 (2010)
5) C. Mabire and P.-L. Hereil, *J. Phys. IV France* **10**, Pr9 749 (2000).
6) P.-L. Hereil and C. Mabire, *J. Phys. IV France* **10**, Pr9 799 (2000).