| ESRF | **Experiment title:**<br>EXAFS investigations on the origin of size and interface effects on the crystallization mechanism of Phase-Change Materials ultra-thin films | **Experiment number**:<br>MA-2719 |
|---|---|---|
| **Beamline**:<br>BM08 | **Date of experiment**:<br>from: 2016/02/05 to: 2016/02/09 | **Date of report**:<br>2016/11/08 |
| **Shifts:**<br>18 | **Local contact(s)**:<br>F. d'Acapito | *Received at ESRF:* |

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**Report:**

Due to technical problems on the LISA beamline prior to our experiment MA-2719, initially scheduled between the 2016/02/03 and the 2016/02/09, the starting of the experiment has been delayed and reduced of 7 shits limiting thus the number of samples being measurable. In that context, we decided to measure a selected number of samples and only at the Ge K-edge, which is from our past experience the most relevant edge for a first investigation. The machine was in 7/8+1 multibunch mode allowing EXAFS measurements on thin films thanks to the high flux. The GeTe chalcogenide thin and ultrathin film samples have been investigated at the Ge-K edge in fluorescence mode. The samples were mounted on the GIXAS setup in order to make data collection at low incidence angle (2 deg) for improving sensitivity and with a parallel polarisation. All samples were measured at 300K or at low temperature around 110K. Finally, we have been able to successfully measure 14 thin film samples with sufficient signal to noise ratio:

- Bulk amorphous GeTe reference samples with a particular care on the effect of the drift due to ageing on the structure of the amorphous phase as we have shown in reference [1]. $k^2.\chi(k)$ spectra of 2 prototypical GeTe samples in 2 different ageing states are plotted in *Fig.1* in order to illustrate the structural difference due to ageing at room temperature.

- Confined amorphous GeTe films exhibiting a significant change in the crystallization temperature. For instance, $k^2.\chi(k)$ spectra depending on the confinement of GeTe are given in *Fig.2*.

- Crystallized GeTe samples as references for quantitative data analysis.

The data from this experiment are of high quality and are currently under treatment in combination with *ab initio* simulations This should in principle permit to get a better understanding of structural changes in amorphous GeTe with the scope to give a better insight on scaling effects on phase change properties of phase change materials at ultimate dimensions.

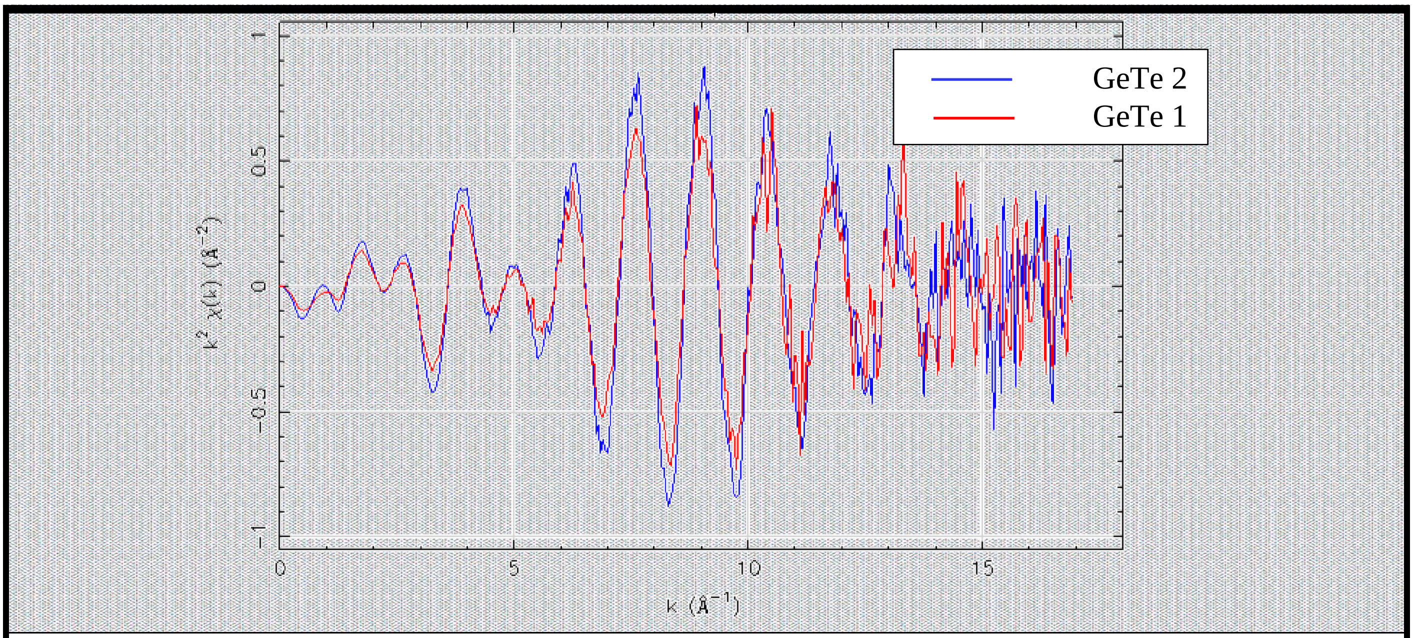


Fig.1: $k^2.\chi(k)$ spectra of EXAFS data acquired at 300K on amorphous GeTe samples with 2 different ageing states showing the impact of structural relaxation on amorphous structure.

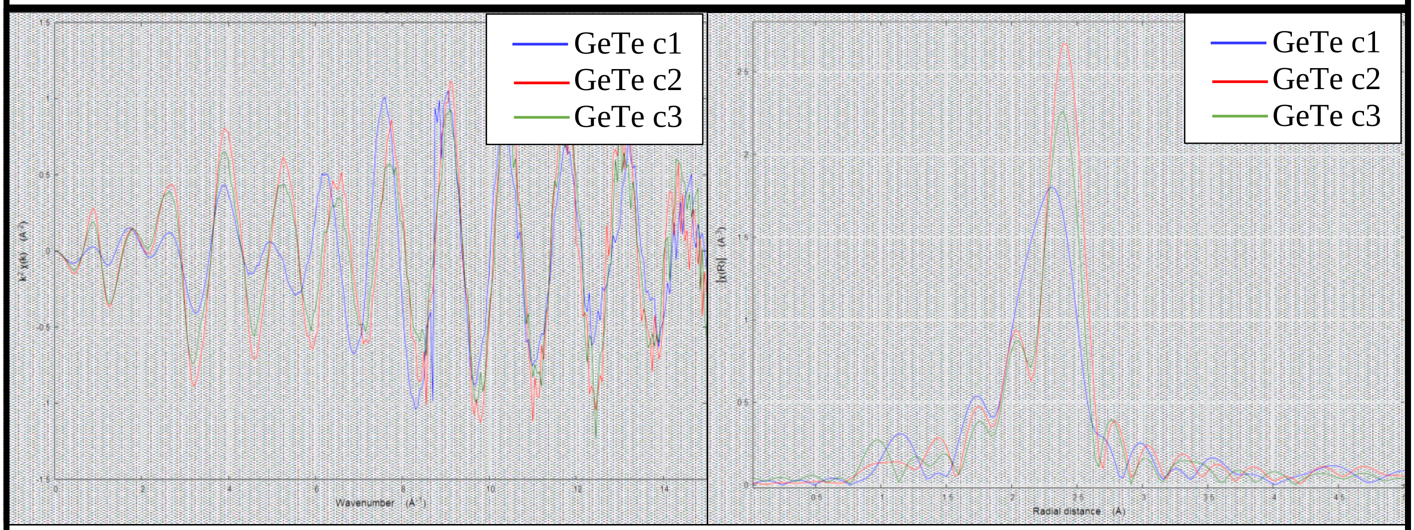


Fig.2: $k^2.\chi(k)$ spectra of EXAFS data (left) and corresponding Fourier transform (right) acquired at 110K on amorphous GeTe samples with different geometrical confinement leading to significantly different crystallization temperature.

[1] P. Noé, C. Sabbione, N. Castellani, G. Veux, G. Navarro, V. Sousa, F. Hippert, and F. d'Acapito, J. Phys. D. Appl. Phys. **49**, 035305 (2016).