ESRF	**Experiment title:** Analysis of the crystalline and amorphous states in GeSbTe thin film used in rewritable Digital Versatil Disk	**Experiment number**: HS 1251
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Report:

The important goals in the research of Phase Change (PC) optical recording are to achieve a high recording density and a high data rate. A higher data rate requires that the recording layer has a higher crystallization speed. The understanding of the physics underlying writing (amorphization of the PC material) and erasing (crystallization of the recording layer) processes is therefore fundamental for the future developments of erasable PC recording .

It's well known that the crystallization time of amorphous $Ge_{22.2}Sb_{22.2}Te_{55.5}$ films is less than 100 ns whereas amorphous GeTe films show slower crystallization speed (300ns). The present EXAFS study has allowed us to investigate the reason for this fast crystallization phenomenon and the origin of the crystallization behavior difference between the two materials.

The spectra analysis (Figure 1) showed that the chemical short-range order in the ternary GeSbTe is almost the same in the amorphous phase and in the corresponding one. This chemical local order already present in the amorphous phase is likely responsible for the fast crystallization process. The phase change is indeed completed without appreciable atomic movement. The "amorphous" atoms move only on very small distances to reach the crystalline sites.

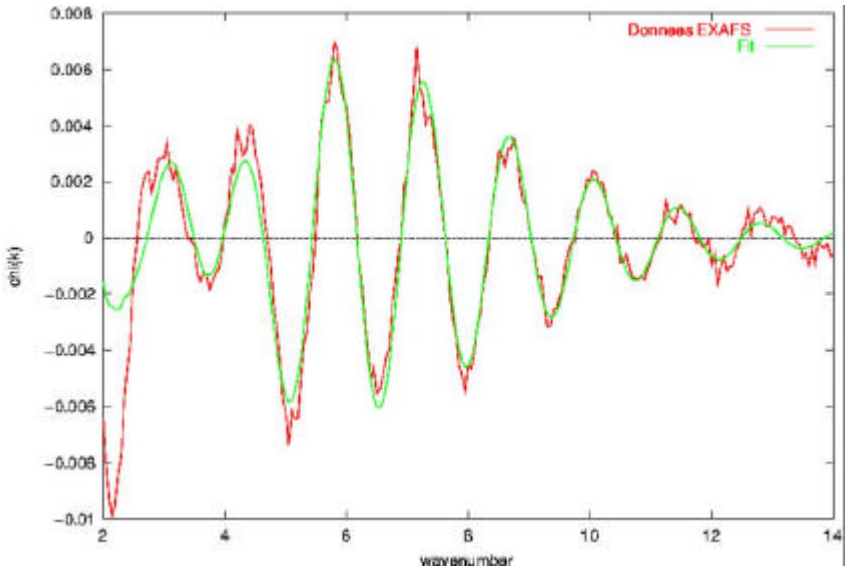

Figure 1：simulation of the EXAFS spectrum (c(k)) at the Te-K edge for the amorphous GeTe. Red curve shows the experimental data and green curve shows the fitted function

In turn, for the binary system (Figure 2), it appears that the local atomic order of both states are different. In the amorphous state, Ge atoms are fourfold coordinated by 2 Te and 2 Ge atoms (the Ge-Ge bond length is 2.19Å). When crystallization occurs the Ge-Ge bonds disappear in the nearest-neighbor shell of the crystalline GeTe, and Ge atoms are uniquely surrounded by Te atoms. The Ge nearest neighbors atoms around the central Ge are then located in the second coordination sphere at the minimum distance of 4.15Å. The phase transformation (amorphous state-crystalline state) requires the destruction of the Ge-Ge bonds and a significant movement of the Ge atoms to join the crystalline sites. This phenomenon limits probably the crystallization speed.

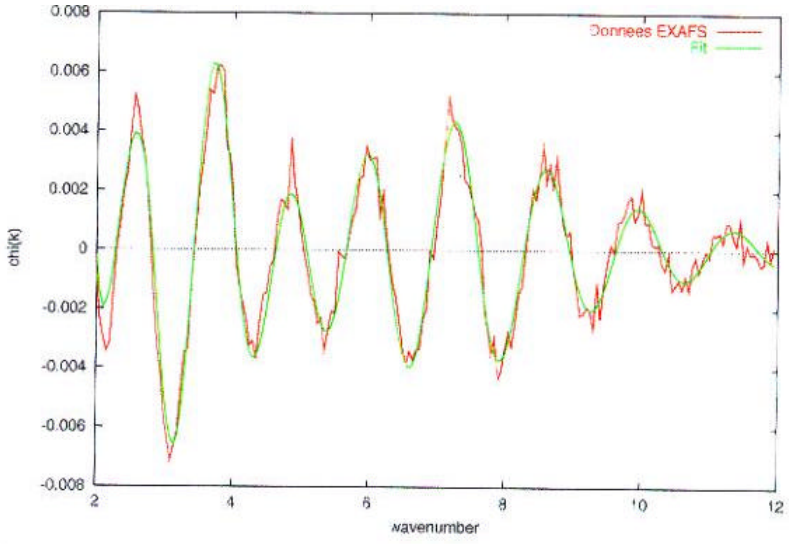

Figure 2 : simulation performed on the amorphous GeSbTe at the Te-K edge. The red line shows experimental data and the green curve the result of the simulation