On how to fabricate single crystalline and highly ordered GeTe-Sb_2Te_3 alloys on Si(111)

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Phase Change Materials (PCMs) are suitable for data storage applications[1] in virtue of the high optical and electrical contrast between amorphous and crystalline phase (resistivity changes up to 6 orders of magnitude), in addition to the fast crystallization times (100 ns). The materials used so far for both applications and academic studies where grown mainly by sputtering or other techniques leading to a polycrystalline material. The use of a higher quality material is appealing for both efficient memory cells fabrication and dynamical studies of the complex switching mechanism. Here we present a fundamental advance for PCMs in terms of material fabrication through molecular beam epitaxy (MBE) equipped with in situ reflection high-energy electron diffraction (RHEED). In particular we will focus on the way we suppressed the presence of rotational domains in epitaxial GeTe-Sb_2Te_3 alloys (GST) films grown on Si(111) by surface ingeneering[2]. In addition, X-Ray diffraction study shows that the film has a single out-of-plane orientation. (see Fig. 1 a)) and the presence of superstructures due to vacancies ordering into (111) oriented layers, so far only predicted by theory[3].

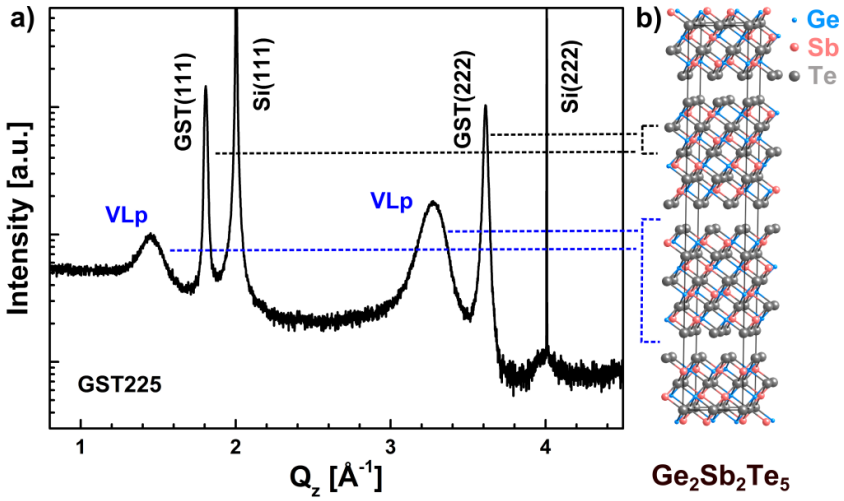

Fig. 1: a) Symmetric ω-2ϑ scan of GST225 grown on Si(111). b) Corresponding crystal structure with GST bilayer (black slashes) and vacancies layers (blue slashes) periodicity, origin of the GST Bragg reflection and of the superstructure peaks called VLp in the XRD profile.

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