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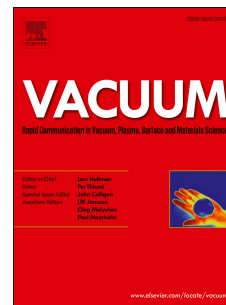
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**Investigation of laser-irradiated structure evolution and surface modification by  
in situ Micro-Raman spectroscopy**

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The structure evolution and surface modification of the ZnSb, ZnSb-Bi and ZnSb-NiO phase-change films are detected by in situ Raman laser irradiation with the different laser power and irradiation time. The results show that undoped ZnSb films exhibit a phase transformation from amorphous to metastable phases at 250mW. The Bi-doped ZnSb films exhibit two different crystallization behaviors as the laser power increases. The films containing low Bi-doping concentration exhibit an amorphous-to-metastable phase transition, while the films containing high Bi-doping concentration directly crystallize into a mixture of new Bi-related crystalline phases and metastable ZnSb phases. As for ZnO-doped ZnSb films, the structure evolution encounters an amorphous phase, metastable ZnSb phase or mixture of both. Identifying the structure evolution in the metastable phase by in-situ Raman measurement method is of great significance for phase change memory application.

**Keywords:** Thin films; Raman spectra; Laser irradiation; Metastable phases

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