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Innovations and developments in Ge gamma undulators with Pulse Laser Melting

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Crystalline based undulators are breakthrough devices for the development of novel gamma-ray Light Sources (LS). These devices, operating at photon energies from 100 keV up to GeV, represent a new approach for gamma ray production. Taking advantage of the channelling phenomena, it is possible to expose of an oriented crystal (linear, bent or periodically bent) to the relativistic particles beams. Ultra relativistic beams can be confined within the atomic channels formed by crystalline planes and forced to follow the periodic trajectory imposed by the bent curvature of the crystal with consequent emission of brilliant and directional light.
This study is focused on the possibility to induce strain in semiconductor monocrystalline materials with extremely precision with the pulse laser melting (PLM) process in order to control the bending requirement for these devices.
This particular technique has recently been succeeded to induce strain in Ge/Si monocrystal semiconductors due to the possibility to realize surface stressor layers by introducing a high concentration of impurity atoms within the first few hundred nanometers, well above the equilibrium solid solubility in these materials.
In this work we describe the main results we obtain for the highest strain and curvature on Ge samples (with Sb dopant) by variation of some laser annealing work parameters (energy, number of pulses, amount of impurity atoms on the coated surface) for different crystallographic directions.
The structure of the layer was studied by X-ray diffraction and Raman spectroscopy while curvature by surface profilometry.
Furthermore, we will show first results of undulator prototypes realized by combination of UV maskless lithography and PLM process.
These prototypes, with different pattern of stressor layers geometry in order to optimize the homogeneity and harmonicity of the curvature of the inner part of the crystal, will be characterized by Raman Spectroscopy and electrical AFM measurements.

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