Contribution ID: **85** Type: **Poster**

Temperature dependence of Raman scattering of Ge and GeSn layers

Saturday, November 26, 2022 4:00 PM (2 hours)

Germanium (Ge) and GeSn materials are very promising candidates for complementary metal-oxide-semiconductor electronics and photonics applications due to their high electron mobility and the possibility to achieve direct bandgap by tuning composition or strain. These are excellent perspectives for devices such as lasers, light-emitting diodes, photodetectors, and modulators. The vibrational properties of these materials can be related to the high quality of the material required for applications, as well as to electron-phonon and phonon-phonon interactions. To this aim, Raman spectroscopy is a well-suited technique that provides non-destructive testing and detailed information about thermal expansion, and anharmonicity.
In this work, Raman spectroscopy was used to study Ge and GeSn layers, through the analysis of the spectra in terms of peaks position, width, and asymmetry of the lineshape. Temperature dependence was measured from 80 to 573 K and analyzed by a model that considers thermal expansion, anharmonicity of the vibrations, and strain.
Ge layers were grown by Chemical (CVD) and Physical (PVD) vapor deposition process. Narrow peaks in high-quality epitaxially CVD-grown layers that evolve with temperature increase were observed. In poly-crystalline samples deposited on SiO2 by PVD, Ge peaks were asymmetric and two times wider than on the Si substrate. The polycrystalline samples have the strongest anharmonicity, although it does not differ from the crystalline materials by more than 15%.
In thin, compressively strained GeSn alloy layers, grown by CVD with Sn concentration in the range of 5%-14%, the anharmonicity is more significant than in the polycrystalline Ge, and independent of the Sn content. These results will assist future developments for optoelectronics and thermoelectrics in semiconductors in group-IV semiconductors.

Category

Solid State (Experiment)

Author: RYZHAK, Diana (IHP –Leibniz-Institut für innovative Mikroelektronik)

Co-authors: CORLEY-WICIAK, Agnieszka Anna (IHP –Leibniz-Institut für innovative Mikroelektronik); MANGANELLI, Costanza Lucia (IHP –Leibniz-Institut für innovative Mikroelektronik); CONCEPCIÓN, Omar (Peter Grünberg Institute 9 (PGI-9) and JARA-Fundamentals of Future Information Technologies (JARA-FIT)); ZOELLNER, Marvin Hartwig (IHP –Leibniz-Institut für innovative Mikroelektronik); SKIBITZKI, Oliver (IHP –Leibniz-Institut für innovative Mikroelektronik); BUCA, Dan (Peter Grünberg Institute 9 (PGI-9) and JARA-Fundamentals of Future Information Technologies (JARA-FIT)); CAPELLINI , Giovanni ((1) IHP –Leibniz-Institut für innovative Mikroelektronik. (2) Dipartimento di Scienze, Università Roma Tre); SPIRITO, Davide (IHP –Leibniz-Institut für innovative Mikroelektronik)

Presenter: RYZHAK, Diana (IHP –Leibniz-Institut für innovative Mikroelektronik)

Session Classification: Poster session

Track Classification: Physics Posters