Temperature dependence of energy gap in GeSn alloys

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Recently, there has been a rapid growth of interest in new semiconductor alloys, which consists of elements from the IV-group and one of them is Ge_{1-x} Sn_x. Properties of this alloy such as the tunable energy gap from 0.80 eV to 0.35 eV for 0 %-15 % Sn concetraction, the possibility of high electron and hole mobility, and the compatibility with the silicon technology are the main reason of this interest[1].

The accessibility of highly advanced growth techniques (molecular beam epitaxy and chemical vapor deposition) has enabled to produce is Ge_{1-x} Sn_x layers with good crystallinity [2, 3] in spite of large lattice mismatch (~15%) and low (<1%) solid solubility of Sn in Ge. Because of these facts it is very important to investigate optical properties of these alloys, the dependence between the energy gap and Sn content, as well as the influence of temperature on these properties. Another issue is the critical concentration of Sn, which causes a transition from indirect to direct bandgap.

In this work we will present the application of electromodulation spectroscopy to study the temperature dependence of energy gap in the temperature range of 20-300K of Ge_{1-x} Sn_x layers with various Sn concentration. The samples used in this study have been grown by chemical vapor depositon. Moreover, the dependence between the value of energy gap and the concentration of Sn atoms was studied in the content range of 6.4%-10.2% of Sn. The energy gap of is Ge_{1-x} Sn_x layers was determined from photoreflectance (PR) and contactless electroreflectance (CER) measurements Varshni coefficients were extracted from the temperature dependence of energy gap and compared with Varshni coefficients typical for other semiconductors. In addition, the influence of built-in strain on the energy gap was considered.

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[3] F. Gencarelli et al., Thin Solid Films 520, 3211 (2012)