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IMPEDANCE SPECTROSCOPY OF GeSn/Ge/Si STRUCTURES AT DIFFERENT TEMPERATURES

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Structures with GeSn films of different thicknesses CVD-grown on Ge/Si substrates were studied by temperature-dependent spectroscopy of impedance Z = Z1 + iZ2 within 1 - 1000 kHz. At lower temperatures, the films revealed insets of the photosensitivity characteristic for interband excitation of GeSn, Ge (direct bandgap) and Si. From the frequency dependencies of real Z1 and imaginary Z2 parts of the impedance, the conductances and carrier relaxation times of the structures at temperatures from 80 to 300 K were extracted. The structures with GeSn films are found to have low-temperature conductivities two order higher and, respectively, relaxation times two order faster than the reference substrate Ge/Si (without GeSn), which reveals an ordinary semiconductor-like temperature dependence of conductance slowly rising at lower temperatures and highly increasing above ˜200 K following ˜ exp[–E/(kT)] with the activation energy E of ˜350 meV, which is close to the half of Ge bandgap near 0 K. Contrarywise, the dependences for the GeSn/Ge/Si structures are non-monotonous, passing a minimum at higher temperatures, which is attributed to higher (metal-like) GeSn conductivity. The impedance measurements under illumination within the Si interband excitation show that the photoconductivity versus temperature has a peak at the range of the dark conductance minimum. The data are explained within the ideas of the conductivity of multilayered structures.
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