Nanooptics and photonics

Nanostructures with Ge–Si quantum dots for infrared photodetectors

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In this work the noise and signal characteristics of infrared photodetectors with germanium quantum dots on silicon are considered [1, 2]. Photodetectors under study are the vertical p^+–p–p^+ structures with ten layers of Ge quantum dots with average lateral sizes of 15 nm and surface density about $3 \cdot 10^{11}$ cm^{-2} separated by Si layers and embedded in the *p*-region. Photosensitive area was equal to $A_d = 10^{-2}$ cm^2. The dark current and detectivity of detectors with the consideration of thermal emission and tunneling of charge carriers are calculated in the approximation of generation-recombination noise limited performance or background limited performance (BLIP). The comparison of obtained results with experimental data [3] is carried out. An attempt is made to find optimum growth conditions in the process of molecular beam epitaxy for the fabrication of infrared photodetectors for the spectral range of 3–5 μm with higher detectabilities in wide range of temperatures. It is shown, that to reach high values of detectivity of quantum dot photodectors it is necessary to synthesize the ensembles of Ge quantum dots in the method of molecular beam epitaxy at growth temperatures of 500–600 °C. It is also ascertained that in the case of achievement of high values of homogeneity of island array the quantum dot photodetectors may successfully compete with HgCdTe photodetectors and even outperform them in terms of detectivity at high operating temperatures.

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3. *Yakimov A.I.* Ge/Si heterostructures with Ge quantum dots for mid-infrared photodetectors // Optoelectron Instrument Data Process.-2013.-**49**.-P. 467-475.