Nanocomposites and nanomaterials

Fabrication of nanostructured objects by thermal vacuum deposition of Ge films onto (100)GaAs substrates

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Thermal vacuum deposition of Ge films onto GaAs substrates were studied widely in the sixties (see, for example, [1]). But because of unsatisfactory quality of such the films for device applications (defectiveness, amorphous or polycrystalline character), this simple method of evaporation has been forced out by more perfect technologies (molecular beam epitaxy, chemical-vapor deposition, high-vacuum magnetron sputtering et al.) which has allowed to bring the Ge films on GaAs up to device quality (for example, [2]).

At the same time, a new field of science has appeared, in the framework of which polycrystalline (more exactly - nanocrystalline) character of the Ge film is just desirable property. This field of science is nanophysics [3]. In this connection we report here about using this simple and low-cost method for deposition of Ge onto substrates of (100)GaAs and (111)Si. Different regimes of the film deposition have been studied and those of them which result in nanocrystalline Ge films have been found. Then structural (by means of Raman spectroscopy and atomic force microscopy) and electric properties of such the films have been investigated.

It was shown that in the case of GaAs substrate, Ge films are nanocrystalline if deposition temperature is 380ºC and more. Herewith the thinner the film, the smaller are all characteristic scales of nanocrystallites forming the film - their effective lateral diameter, vertical size and the surface roughness. As for the electric properties, temperature dependence of the film conduction is described well by the Mott's law, i.e. physical mechanism of the conduction is variable range hopping.

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2. *S.-H. Tang et al.* High quality Ge thin film grown by ultrahigh vacuum chemical vapor deposition on GaAs substrate // Appl. Phys. Lett.-2011. - **98**, 161905.
3. *Gleiter H.* Nanostructured materials: basic concepts and microstructure // Acta Materialia.- 2000.- **48,** N 1.-P. 1-29.