FORMATION, PROPERTIES AND APPLICATION OF COMPOSITE MATERIALS BASED ON POROUS SILICON AND METALS

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Semiconductor silicon is a main material of semiconductor electronics and one of the most successful artificial material created by man. Physical properties of silicon are very well studied and, to date, scientists have almost exhausted the possibilities of changing these properties by traditional methods based on implantation and diffusion of desiable elements in silicon. In this regard, there is a great interest in finding new methods for creating silicon-based composite materials exhibiting properties that silicon does not have at all (for example, magnetism) or these properties are very weak (for example, luminescence). Such composite materials have been identified as a new solution for a significant expansion of the functional abilities of silicon to create new systems consisted of opto- and magnetoelectronic devices integrated with electronic circuits on the silicon wafer.

This presentation is a review of the research of our group aimed at developing a simple and efficient technology for the synthesis of composite materials that can be easily integrated with silicon wafers. Our approach consists in the formation of pore channels in a silicon crystal that are directed perpendicularly from the surface to the depth of the crystal, and then filling the pore space with another material which provides the properties that silicon does not have.

Ferromagnetic metals nickel, cobalt and iron are introduced into the pore channels to impart magnetic properties to composite materials. To ensure the luminescent properties, rare-earth metals and zinc oxide are deposited in porous silicon. Nanoparticles of noble metals silver and gold are formed on the surface of porous silicon and in the channels of its pores to ensure the plasmon properties of the composite material.

Structure of composite materials based on porous silicon and their physical properties, as well as possible applications are presented in this paper.