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New approach to the synthesis of porous silicon with silver nanoparticles using ion implantation technique

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Abstract

A new technique for the synthesis of porous silicon layers with silver nanoparticles has been proposed which is based on the high-dose low-energy implantation of crystalline silicon with metal ions. In order to demonstrate this technique, in this work we implanted a polished wafer of monocrystalline silicon Ag⁺-ions with an energy of 30 keV at a dose of 1.5×10^{17} ion/cm² and a current density in the ion beam of 4 μ A/cm². Using high-resolution scanning electron and atomic force microscopy, as well as X-ray spectral microprobe analysis and Raman scattering, it is shown that an amorphous layer of a porous silicon is formed at the surface of silicon as a result of implantation with average sizes of pore holes on the order of 150-180 nm; depth of about 100 nm; and thickness of the walls of 30-60 nm, in whose structure silver nanoparticles are located with a diameter of 5-10 nm. In addition, it is shown that the formation of pores by implantation with silver ions is accompanied by sputtering the surface of silicon. © 2014 Pleiades Publishing, Ltd.

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