INFLUENCE OF THE HF VAPOR TREATMENT ON THE STRUCTURE AND LUMINESCENCE PROPERTIES OF POROUS Si/SiO_x NANOCOMPOSITES

V.A. Dan'ko, S.O. Zlobin, I.Z. Indutnyi, I.P. Lisovskyy, V.G. Litovchenko, K.V. Michailovska, P.E. Shepeliavyi

V. Lashkaryov Institute of Semiconductor Physics,
Nat. Acad. of Sci. of Ukraine
(*41, Nauky Prosp., Kyiv 03028, Ukraine*)

S u m m a r y

By methods of IR-spectroscopy and photoluminescence, we studied the influence of the etching of the oxide matrix of porous nanocomposite Si/SiO_x structures by HF vapors. The structures were produced by the thermal deposition of silicon monooxide in vacuum at an angle of 60° on c-Si substrates with the subsequent annealing at 975 °C. It is shown that the treatment in HF vapors causes a significant decrease in the volume of a film and a partial additional oxidation of its surface, as well as to the appearance of complexes O_3SiH and O_2SiF_2 in the film. On the surface of silicon nanoinclusions, complexes Si_3SiF arise. Simultaneously, an essential (up to 210 nm) shift of the emission maximum from the infrared range to the visible one of the spectrum and a significant (up to 200 times) increase in the luminescence intensity are observed. These effects can be explained by the process of modification of a structural impurity-involved state of the nanoinclusion-Si–SiO_x interface as a result of the action of an etcher on a porous film. The light emission intensity grows due to the passivation of broken bonds of silicon on the nanoinclusion-Si–SiO_x interface by atoms of oxygen and fluorine. The oxidation of the surface of silicon nanoinclusions decreases their size, which is revealed in a short-wave shift of photoluminescence (PL) spectra.