Evolution Of Nanoporous Silicon Phase Composition And Electron Energy Structure Under Natural Ageing


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Investigations of electron structure evolution in nanoporous silicon during natural ageing for the time period up to one year was performed with the use of the USXES and XANES techniques. Nanoporous silicon samples were obtained using standard electrochemical etching technology in HF solution of c-Si wafers doped with P and Sb (por-Si:P and por-Si:Sb) and aged naturally in the atmosphere. All samples of por-Si demonstrated reproducible photoluminescence in the visible spectra range.

The evolution of the electron energy structure proceeds in different way depending on substrate doping type. USXES data reveal similar surface layers phase composition of the freshly made samples but with considerably different kinetics of the phase composition variations with natural ageing. Whereas por-Si:P oxidizes for two weeks according to the activation law, por-Si:Sb phase composition remains almost invariable. After two weeks the oxide phase growth is stopped in por-Si:P. In case of Sb doped samples the oxide phase contribution continues increasing. The presence of different silicon suboxides in surface layers is shown.

The absence of the fine structure in Si L\textsubscript{2,3} XANES main absorption edge (Figure 1) is the evidence of the amorphous silica phase presence. Considerable differences in kinetics of oxidation of the samples surface layers consist in the ratio of oxide and amorphous phases. This ratio prevails in case of por-Si:P aged samples. At the same time for por-Si:Sb samples the situation is opposite. Different ageing kinetics can explain different photoluminescence properties of por-Si:P and por-Si:Sb.

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