Stain-etched porous silicon structure investigated by micro-Raman spectroscopy

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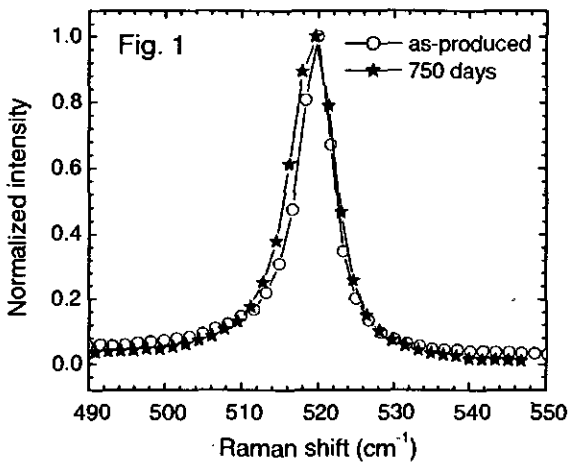
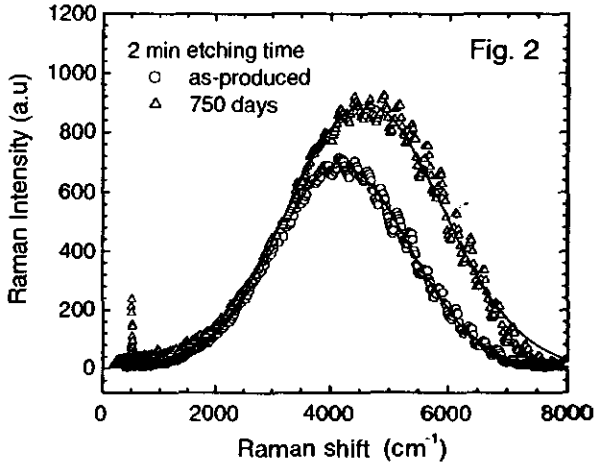
Several sets of porous silicon (PS) layers were produced by stain etching on boron p-type (100) oriented silicon wafers with a resistivity of 0.01 to 0.02 Ω.cm with etching times varying from 1 to 10 min. The micro-Raman spectra of the as-produced samples were measured around the Si peak (300 to 600 cm^{-1}) and, to observe the photoluminescence (PL), in the range of 300 to 8000 cm^{-1}. The first order Raman spectra in the vicinity of Si peak were fitted with a phonon confinement model [1] including a term to account for the amorphous phase [2]. This analysis allows the determination of the correlation length, which corresponds to the crystallite size, and information about the amorphous phase. The photoluminescence band, which corresponds to the Si crystallites located on the outermost part of the PS layer, could be fitted with a Gaussian distribution. In order to investigate the porous silicon structure for different natural oxidation periods and for different conditions of etching, the micro-Raman spectra of all PS samples were measured again in both spectral ranges. Fig. 1 shows the Raman spectra for the sample with 2 min of etching time at two different oxidation periods. A slight decrease on the crystallite size was observed for all samples after all time periods studied, while the spectral part relative to the amorphous phase did not show significant changes. The central position of the PL band of each sample exhibited consistently a shift to higher energies, after the oxidation process, as shown in Fig. 2. The results showed that the natural oxidation modifies the size of Si crystallites at the surface but not increase the amorphous phase. In addition, other sets of PS samples were produced in order to investigate the reproducibility of the stain etching method by confirming this oxidation process independent of the etching time for porous silicon formation.





[1] H. Richter, Z. P. Wang, and L. Ley, Solid State Commun. **39**, 625 (1981).
[2] P.G. Abramof, N.G. Ferreira, A.F. Beloto and A.Y. Ueta, Journal of Non-crystalline Solids, **338-340**, 139-142 (2004).