Photoluminescence spectroscopy during oxidation of Porous Silicon structures

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The photoluminescence (PL) properties of porous silicon (PSi) are influenced by the oxidation process that creates a surface “shell” around the silicon (Si) core and changes the surface species, which is passivated. As the oxide grows, the Si features become smaller and the emission spectrum is shifted to blue side due to quantum confinement effects. At the same time, the PL intensity usually increases due to passivation of surface defects on the emissive Si nanostructure by the growing oxide layer. While it is generally accepted that quantum confinement and defects interface are the fundamentals origins of the PL on PSi. The main idea of this work was to monitor the PL during the oxidation process of PSi chips and investigate how the PL is presented by the defects localized at the Si-SiO_2 interface. The PSi chips were obtained by electrochemical etching process using electrolyte based on hydrofluoric acid and p-type monocrystalline Si wafers (100), 0.01-0.02Ωcm of resistivity. The oxidation was performed in free atmosphere and the samples were placed on a hot plate at 300 °C during 1 and 5 hours. An ultraviolet LED lamp and a 370 nm interference filter was used as an incident light source. The spectrum data was registered at real time during oxidation by the photoluminescence spectroscopy system mounted by our group. Fourier transform infrared spectroscopy confirms the oxide bonds of Si-Si O_2. The thermal oxidation causes a variation in time of the pore volume, i.e. the PSi structure and consequently the PL in a function of time.

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References:
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