

ROOM-TEMPERATURE GREEN PHOTOLUMINESCENCE OF SILICON NANOWIRES COVERED BY DEPOSITED SILICON OXIDE LAYERS

*Pierre NOE, Jérémie GUIGNARD, Pascal GENTILE, Vincent CALVO, Pierre FERRET¹,
Thierry BARON²*

*Laboratoire Silicium Nanoélectronique Photonique et Structure, CEA/DRFMC/SP2M,
CEA-Grenoble 17 rue des Martyrs, 38052 Grenoble Cedex 9*

¹ *Laboratoire de Photonique sur Silicium, CEA/LETI/DOPT, CEA-Grenoble 17 rue des
Martyrs, 38052 Grenoble Cedex 9*

² *Laboratoire des Technologies de la Microélectronique, CNRS UMR 5129, CEA-Grenoble 17
rue des Martyrs, 38052 Grenoble Cedex 9*

pierre.noe@cea.fr

Silicon nanowires (SiNWs) due to their specific dimensions and particular shapes are promising structures for nanoelectronic [1], photonic [2], nano-mecanic, chemical [3] and biological applications. In this context we have studied room-temperature PL of SiNWs covered by silicon oxide. Silicon oxide layers have been obtained by three different deposition techniques such as Plasma Enhanced Chemical Vapor Deposition, magnetron sputtering and electron-beam evaporation.

SiNWs were synthesised by VLS mechanism on (100) and (111) Si substrates at temperatures between 450 °C and 650 °C in a low pressure chemical vapor deposition (LPCVD) reactor. Gold was used as the catalyst and silane (SiH₄) as the Si source. After growth different silicon oxide layers were deposited on the SiNWs samples by electron beam evaporation, magnetron sputtering or plasma enhanced chemical vapour deposition (PECVD). Silicon oxide layers thickness varied from 200 to 1600 nm in order to entirely cap the SiNWs. After deposition samples were annealed at 850°C for one hour under forming gas (N₂+H₂ 95/5) or pure oxygen. SiNWs were observed by scanning electron microscopy (SEM) and by transmission electron microscopy (TEM). High resolution images confirm the crystallographic structure of the nanowires.

Photoluminescence (PL) spectra were realised at room temperature. Excitation was made with the 351 nm line of an Argon laser and PL signal detection was supplied by a silicon CCD camera coupled with a visible spectrometer. We show room-temperature PL spectra, as a function of the silicon oxide elaboration method and the annealing atmosphere. Then the origin of this PL will be discussed as compared to previously reported room-temperature visible photoluminescence from as-grown and oxidized SiNWs [4, 5]. Red, green and blue PL were observed and attributed to the quantum confinement effects and the recombination emissions from the defect centers, respectively.

References:

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Figures:

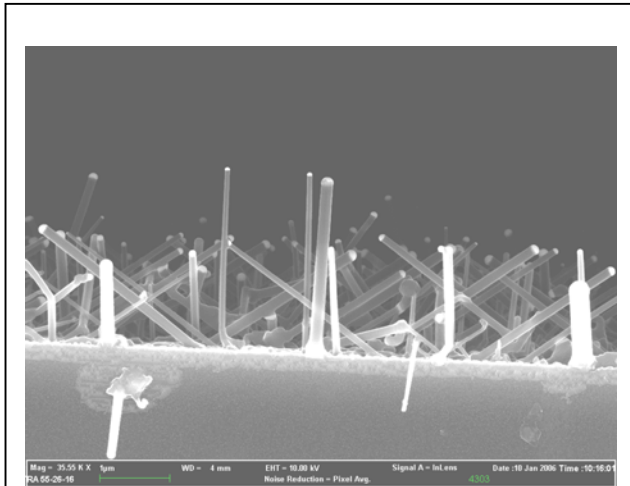


Figure 1 : SEM image of silicon nanowires grown on a (100) Si substrate

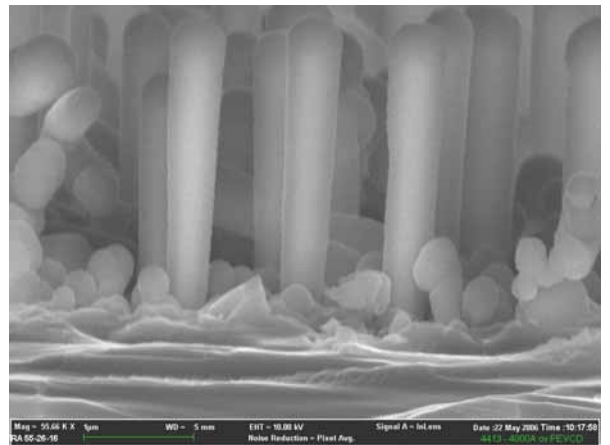


Figure 2 : SEM image of 400nm PECVD silicon oxide deposited on silicon nanowires grown on a (111) Si substrate

