# Luminescence from tin oxide doped silicon nanoparticles grown by off axis pulsed laser deposition.

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## Abstract

Silicon, which is the backbone of microelectronic industry, is not widely used for optoelectronic industry because of its indirect band gap. But silicon nanostructures having a quantum confinement effect have provided a breakthrough to optoelectronic applications because the quantum confinement effect enhances the electron-hole radiative recombination rate[1]. The approach of introducing rare earth elements in to Silicon networks is a very promising alternative. Light-emitting devices made of silicon-based materials can be integrated into the existing microelectronic and optoelectronic technologies in a highly economic way; therefore enormous efforts have been devoted to the development of silicon-based structures that promise efficient light emission in the past decade[2]. From the point of view of optoelectronic applications, such devices should offer tunable light emission with utilizable efficiency in the whole visible light range or at even shorter wavelengths.

In this paper we report the pulsed laser deposition of tin oxide doped Si nanofilms at room temperature. Tin oxide doped Si pellets were used as the target material and fused quartz as the substrate. Concentration of dopant varies from 0.1 at.% to 10 at.%. The deposition was carried out by keeping the substrate in the off axis configuration. A Q- switched frequency doubled Nd: YAG laser (fluence of $4 \times 10^{-6}$ J/m$^2$ at 532 nm, 9 ns pulse width, 10 Hz repetition frequency) was used to ablate the target. .The target was rotated with constant speed to ensure uniform ablation. The substrates were kept at target to substrate distance 3cm and at an off axis distance of 1cm with respect to the axis of the laser plume .The chamber was kept at a base pressure of $5 \times 10^{-6}$ m.bar.

Optical absorption spectra were recorded using a UV-VIS-NIR spectrophotometer (Hitachi U 3410) in the spectral range of 200 – 800 nm. As the concentration of dopant changes a blue shift in the absorption peak is observed. Photoluminescence spectra of the films have been recorded (JobinYvon Spectro flurometer (Flurolog III) and analyzed. Blue shift in the luminescence peak and an enhancement in the intensity of luminescence peak are observed for the films doped with tin oxide. The Raman spectra of the films were recorded by Jobin Yvon Horiba (LABRAM HR 800) with an excitation of 632.8 nm of He – Ne laser. Wave number shift in the position of Raman band were observed for the doped films. The transmission electron microscope image clearly shows that Si QDs are well organized in the silicon oxide matrix. Electroluminesece property of p-Si/$SnO_2$: Si/ n- Si will be investigated.