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Supporting Information

Enhanced photoluminescence and photoactivity from Plasmon sensitized nSiNWs/TiO_2 Heterostructures

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Experimental Section

A) Characterization:

Morphological characteristics of the as synthesized materials was examined by using Quanta 200 3D, FEI scanning electron microscope (SEM). High resolution transmission electron microscope (HR-TEM) images were taken by using FEI Technai 300 keV. X-Ray diffraction studies were carried out on a Phillips PW 1830 instrument operating at 40 kV and a current of 30 mA with Cu Kα radiation. UV–Visible diffused reflectance spectra were recorded using a Jasco V-570 spectrophotometer. The Raman spectra were collected using LabRAM HR800 (Jobin Yvon Horiba, France) with laser wavelength of 632.84 nm (He-Ne Laser, 20 mW of power) and 2 μm spot size. PL data were recorded on Fluorolog Horiba Jobin Yvon fluorescence spectrophotometer using a xenon lamp with an excitation wavelength of 340 nm. Electrochemical measurements along with photocurrent measurements were performed on Potentiostat (Biologic SP 300**,** Netherlands).

B) Experimental Methods:

i) Synthesis of TiO_2 sol.

The sol of TiO_2 is prepared by taking 0.5 ml of Titanium isopropoxide in 5 ml of Ethanol and 0.2 ml of Acetic Acid is added to it. Then 0.5 ml of DI water is added dropwise with sonication for the hydrolysis of Titanium isopropoxide. A white turbidity appears indicating the formation of TiO_2 which was dissolved by adding some amount of dilute HNO_3. The clear solution was thus formed is the sol of titanium. As prepared Ti sol is stable for many days, subsequently used for the TiO_2 coating on n-SiNWs.

ii) Synthesis of n-SiNWs/TiO_2

Electroless metal deposition method is used to synthesize SiNWs. The Silicon wafers cut into small pieces and clean with acetone, isopropyl alcohol finally with DI-water by sonication. The cleaned wafers were then blown dry under N_2 gas. The wafers then treated with piranha solution for 30 minutes (H_2SO_4:H_2O_2, 3:1) to oxidize any organic contaminants and simultaneously creating hydroxylated surface on the Silicon. The etching of silicon is carried out using 0.04 M $AgNO_3$ and 5% HF (1:1) for 5 minutes at 55°C. After etching, SiNWs were kept in 5 M HNO_3 to remove deposited silver. For TiO_2 thin film coating, native oxide layer was removed from the surface of the SiNWs by keeping it in 5% HF solution for 5 min. H-terminated SiNWs array was deep coated for 10 times in TiO_2 sol to form TiO_2 coating on SiNWs. After, complete drying the substrate was annealed at 500°C for 1 hr. under ambient oxygen to form TiO_2 covered n-SiNWs.

iii) Gold deposition on n-SiNWs/TiO_2

For gold deposition the TiO_2 coated samples were soaked in gold salt solution (1mM $HAuCl_4$) for 30 minutes and dried under IR lamp. These samples were then annealed at 400°C (10 minutes) for the gold nanoparticle formation.

C) Photo-Electrochemical (PEC) measurements:

PEC study was carried out in neutral 1 M Na_2SO_4 using three electrode system where Ag/AgCl and Pt foil serve as reference and counter electrodes. All samples were covered with Teflon tape exposing the front side (0.5 cm x 0.5 cm) of the electrode. Contacts were made using Ga-In conducting liquid. Visible light measurements were carried out by irradiating the exposed part of the samples with white and monochromatic LED sources (Luxeon Star, Canada). The photocurrents for each sample were then normalized with respect to per unit area and plotted.

Power outputs for LEDs:

1) White LED - 22.3 mW cm^{-2}

2) Blue LED - 27.07 mW cm^{-2}

3) Green LED - 16.24 mW cm^{-2}

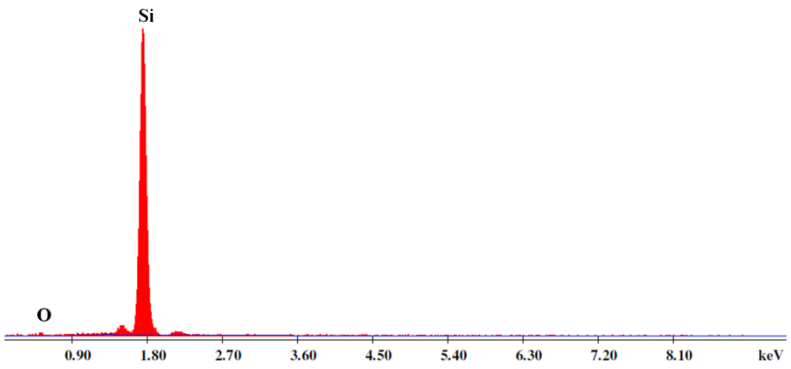
4) Red LED - 21 mW cm^{-2}

Table 1. Energy Dispersive X-ray analysis of the Samples (EDAX):

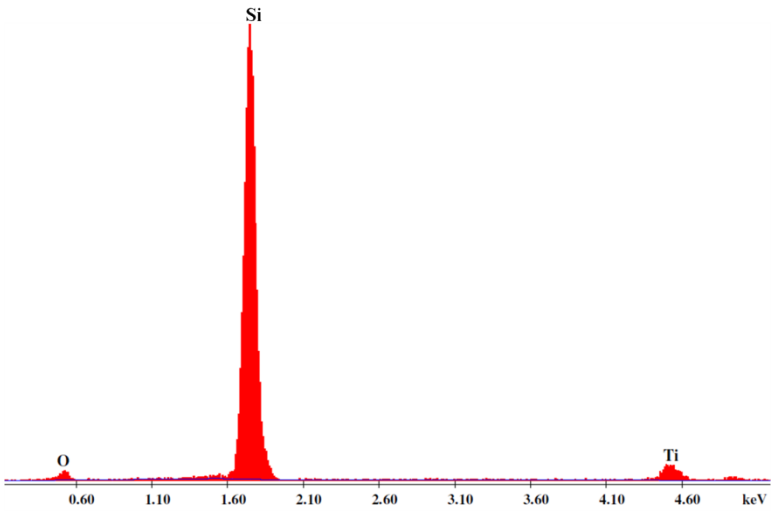
Sample/Elements (Weight Percentage)	**Si**	**Ti**	**O**	**Au**
nSiNWs	**96.18**	-	**3.82**	-
nSiNWs/TiO_2	**80.82**	**7.24**	**11.94**	-
nSiNWs/TiO_2/Au	**81.34**	**9.25**	**7.88**	**1.53**

Energy Dispersive X-ray analysis spectrum of the Samples:

1) nSiNWs:



2) nSiNWs/TiO_2:



3) nSiNWs/TiO_2/Au: