Visible Electroluminescence from silicon nano-crystals embedded in amorphous silicon nitride matrix

Applied Physics Letters, 2005
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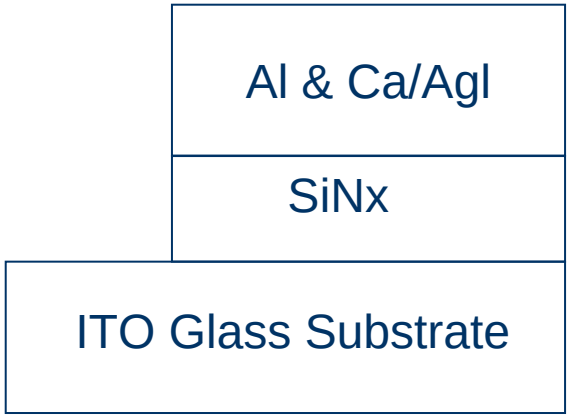
INTRODUCTION

- Nc-Si embedded in a SiOx matrix have been demonstrated to emit visible light by photoluminescence measurements. But only a few papers have reported on the electroluminescence
- In this study, they are using SiNx as matrix rather than SiOx.

EXPERIMENTS

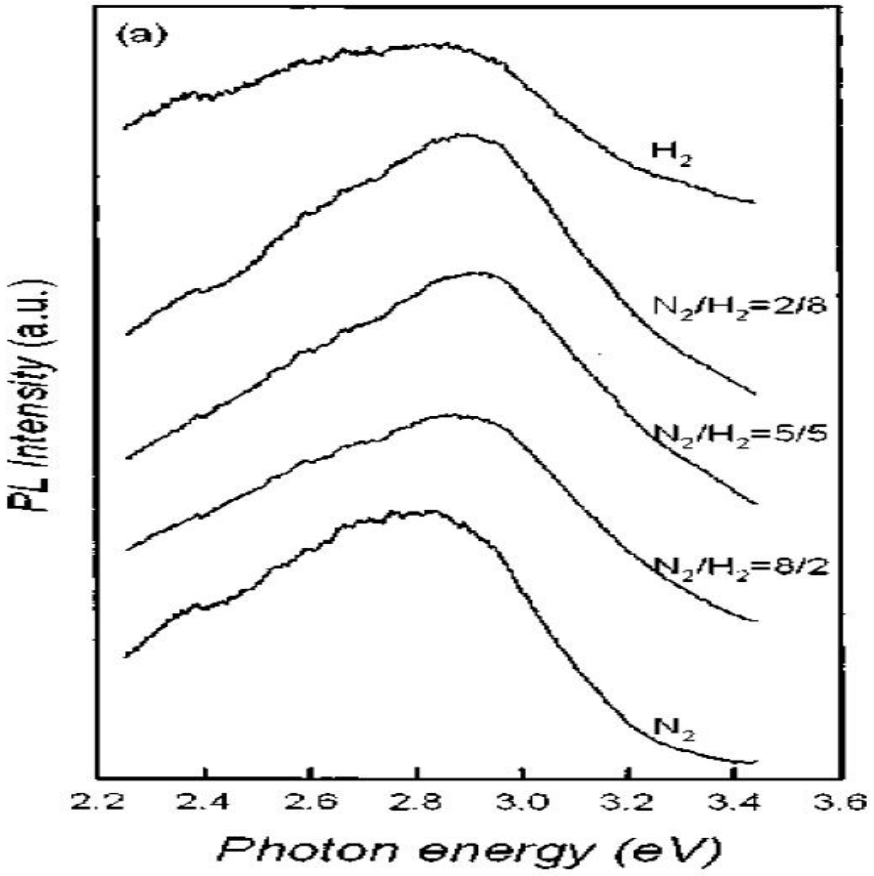


Substrate：ITO Glass & Si(100)

Prepare：using e-beam evaporation of Si into the inductively coupled plasma (ICP)

Gas：N_2 and H_2

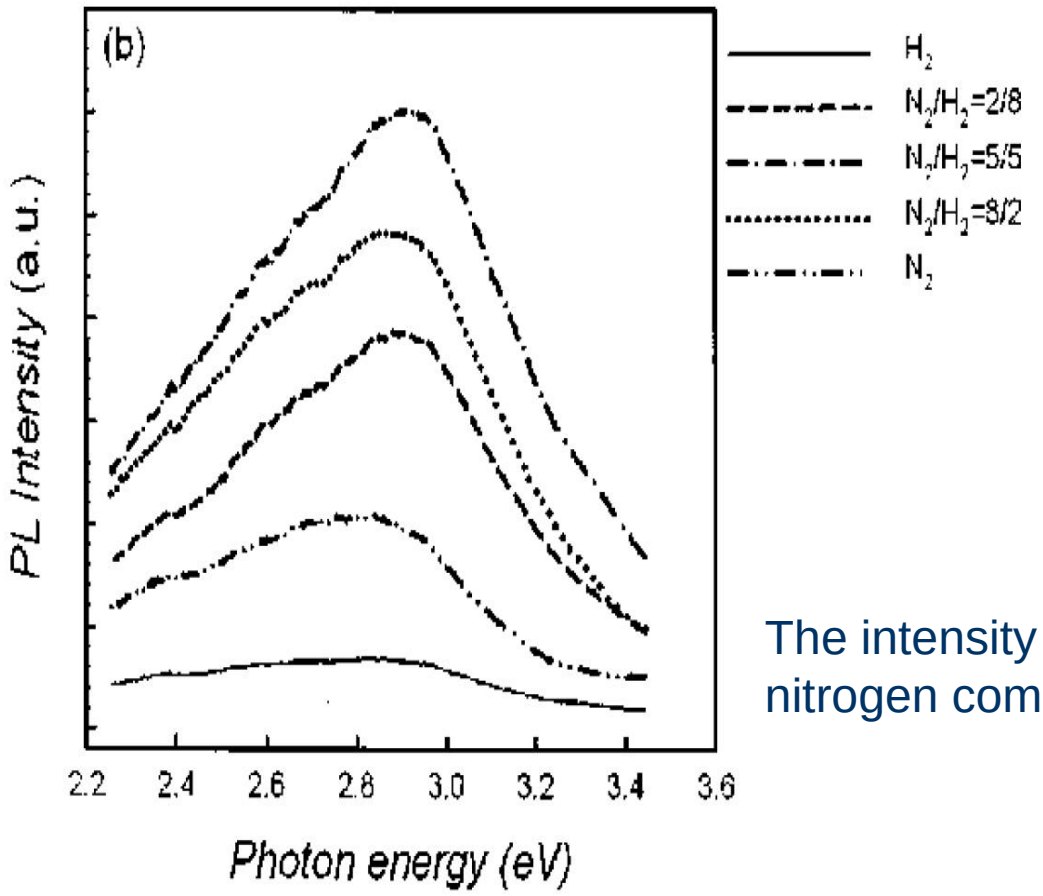
RESULT OF PL MEATSURMENT



A Xe lamp operated at 150w was employed as the excitation source for the PL spectra, and the wave length of excitation is 325nm.

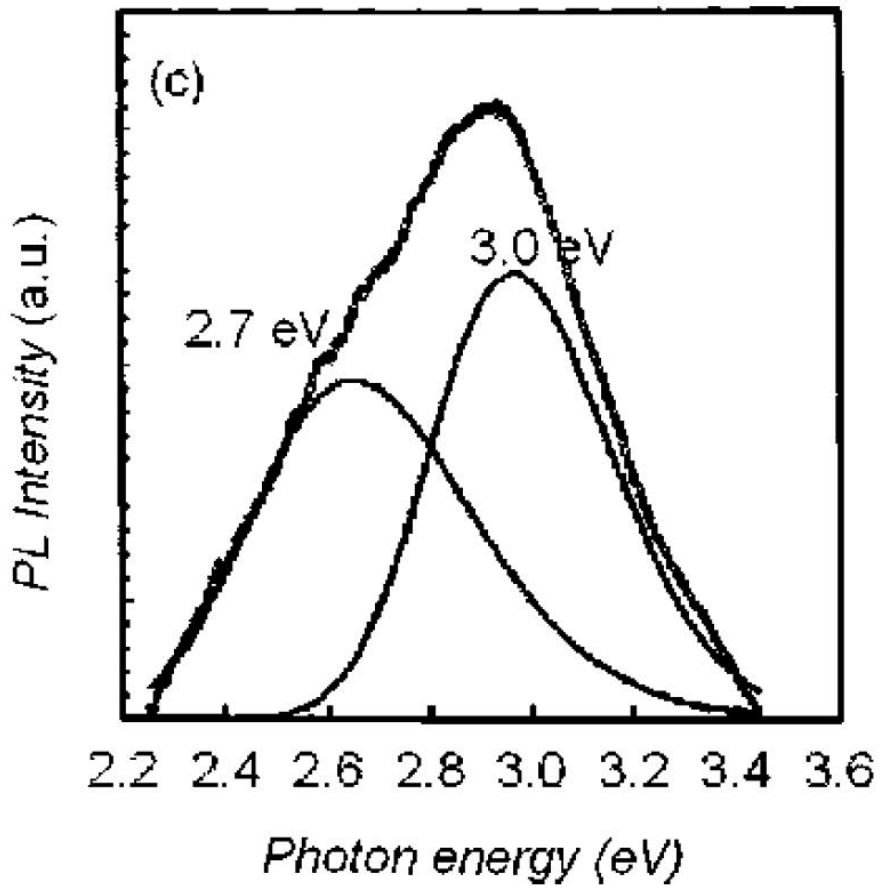
PL spectra of the films deposited at various N2/H2 ratios.

RESULT OF PL MEATSURMENT



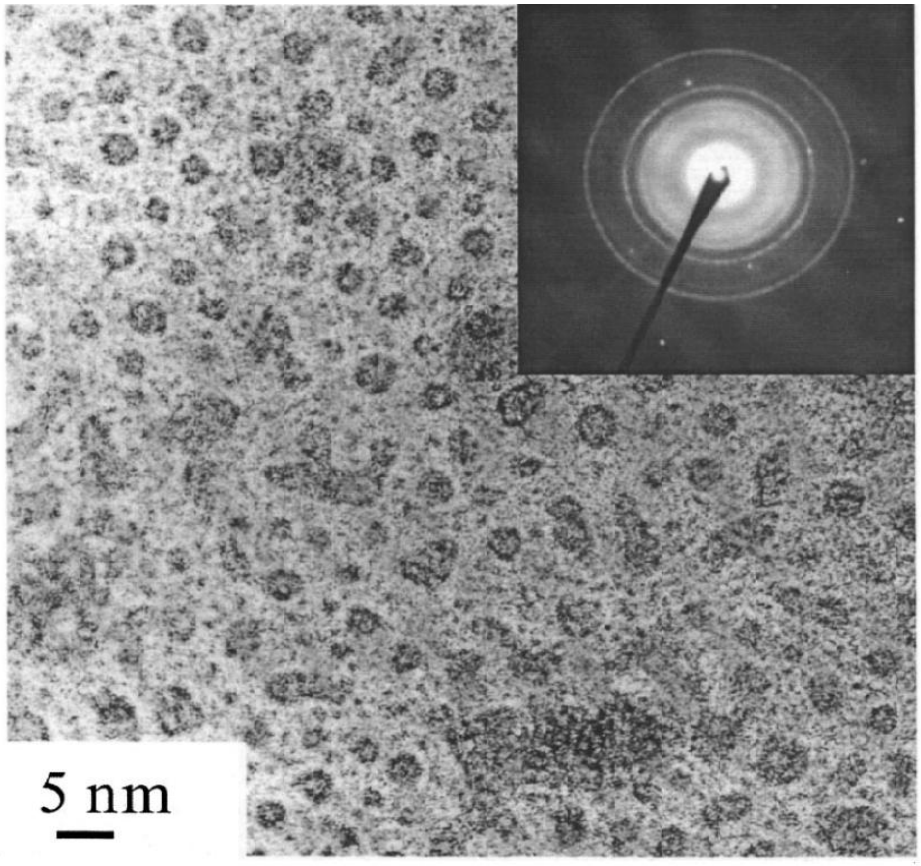
The intensity of PL as a function of nitrogen composition in the gas.

RESULT OF PL MEATSURMENT



The deconvolution of PL spectra at N2/H2=5:5 into two peaks 2.7 and 3.0eV.

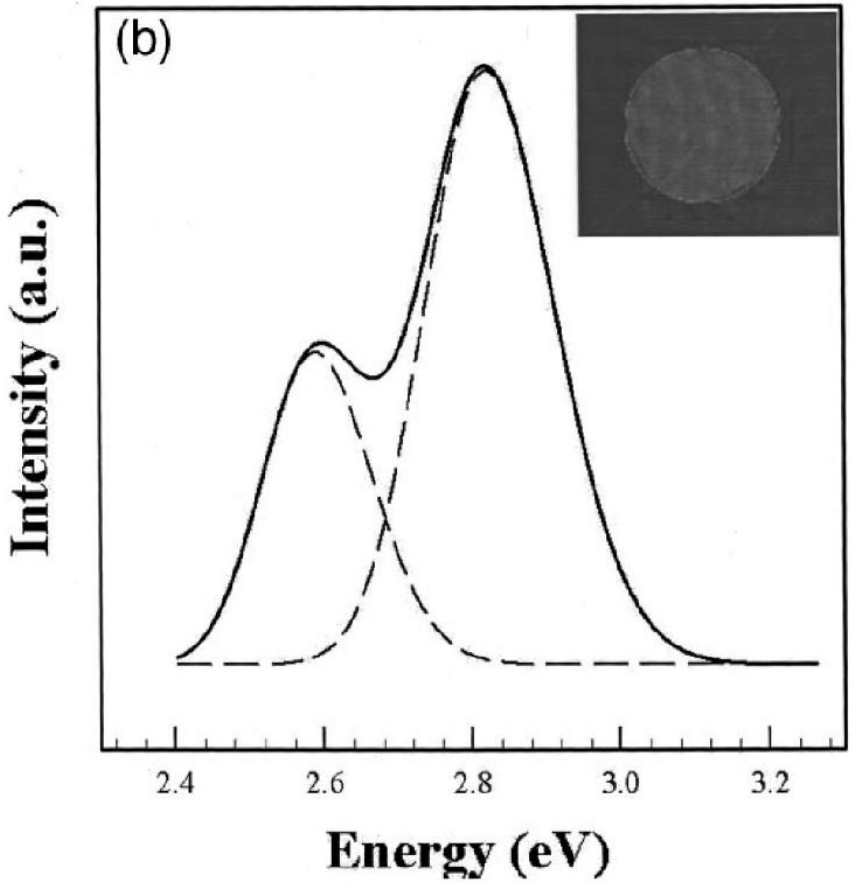
RESULT OF TEM



The sizes of nc-Si were in the range of 1-5nm, and the density of nc-Si was about $5x10^{12}cm^{-2}$.

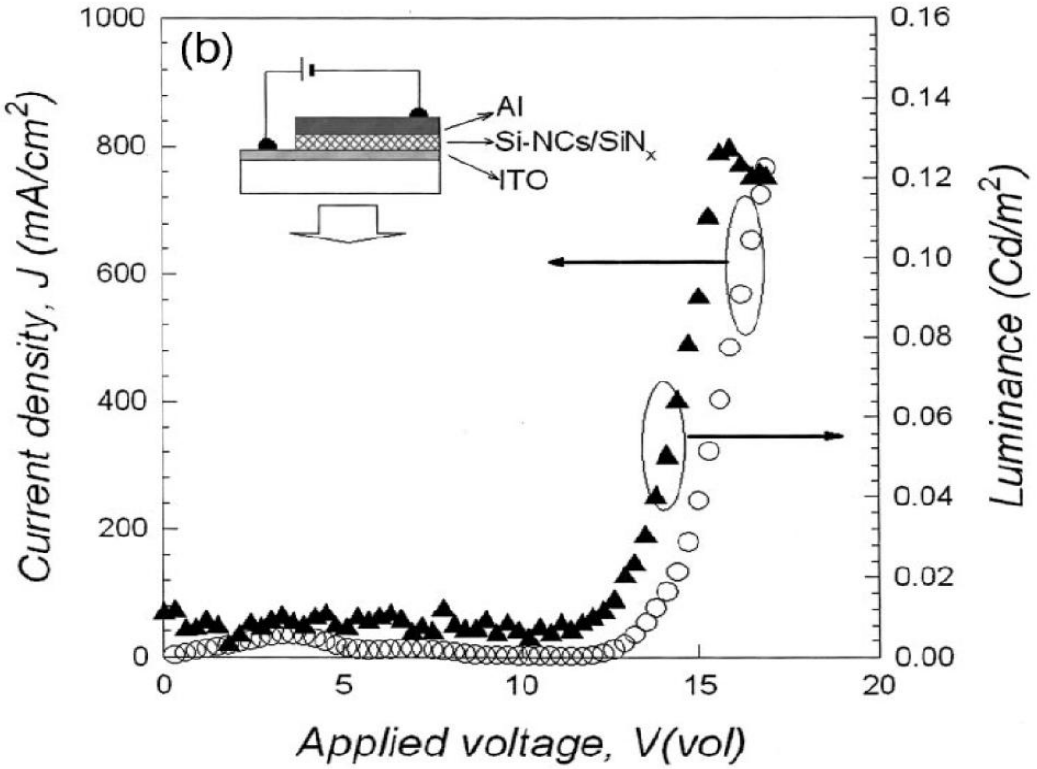
HRAEM image of the nc-Si/a-SiNx nanocomposite. The inset shows a selective area diffraction pattern of Si nanocrystals.

RESULT OF EL MEATSURMENT



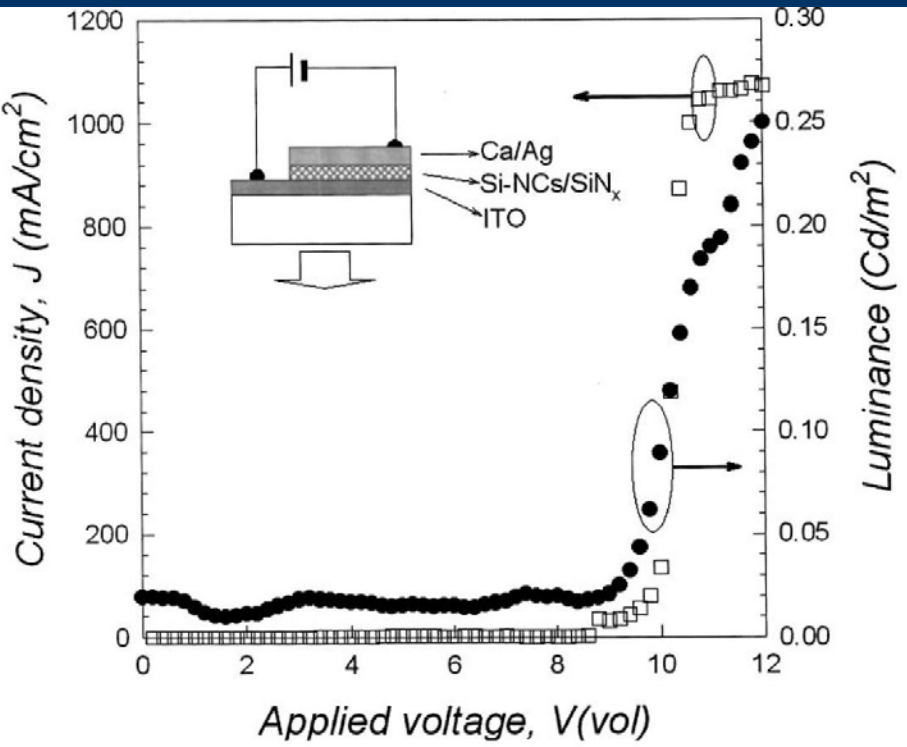
The photograph of EL device emission. The diameter of the pattern is about 2mm

RESULT OF I-V MEATSURMENT



The characteristics of the current density and the luminance versus the forward bias voltage for the nc-Si/a-SiNx film with the the Al cathode measured at room temperature.

RESULT OF I-V MEATSURMENT



The characteristics of the current density and the luminnce versus the forward bias voltage for the nc-Si/a-SiNx film with the Ca/Ag cathode measured at room temperature.

CONCLUSION

- In this study, the main peak of photoluminescence spectra is a blue band.
- For the EL device using ITO, a-SiNx and Ca/Ag as the anode , active layer, and cathode, respectively, the emission was observable with the naked eye through the ITO glass in the dark.