Nanocrystalline Silicon Based Films for Renewable Energy Applications

The work that will be presented summarizes the results obtained in my PhD thesis, which is focused on the study of innovative Si-based materials for third generation photovoltaics. In particular, silicon oxi-nitride (SiO_xN_y) thin films have been characterized in view of their application in photovoltaics.

SiO_xN_y is a promising material for applications in thin-film solar cells as well as for wafer based silicon solar cells, like silicon heterojunction solar cells. However, many issues relevant to the material properties have not been studied yet, such as the role of the deposition condition and precursor gas concentrations on the optical and electronic properties of the films, the composition and structure of the nano-crystals. The results aim to clarify the effects of annealing and oxygen incorporation within nc-SiO_xN_y films on its properties in view of the photovoltaic applications.

Experimental results on SiO_xN_y thin films have been obtained at macroscopical and microscopical level using different characterizations techniques, such as Atomic Force Microscopy (AFM), Reflection and Transmission measurements, High Resolution Transmission Electron Microscopy, Energy-Dispersive X-ray spectroscopy and Fourier Transform Infrared Spectroscopy. The morphological maps obtained with AFM have been analyzed with two different algorithms: Watershed and Height-Height Correlation Function (HHCF). Some preliminary results on simulated AFM maps will be also discussed.

The deep knowledge and improved understanding of the basic physical properties of these complex, multi-phase and multi-component systems, made by nanocrystals and amorphous phases, will contribute to improve the efficiency of Si based solar cells.