PO1015

Progress on the comprehensive understanding of Si film structure and dynamics deposited on glass-substrates and Si-wafers by light scattering

Angelos Kalampounias[1], Ergina Farsari[1], Eleutherios Amanatides[1], Dimitrios Mataras[1]

[1]Dep. Chem. Engineering, Univ. of Patras, Patras, Greece

angelos@chemeng.upatras.gr

Hydrogenated microcrystalline silicon deposited on glass-substrates or silicon-wafers is widely used in manufacturing photovoltaic cells. The high growth rates, the proportion and the distribution of amorphous and crystalline silicon are critical factors for performance and are therefore important to monitor. Vibrational spectroscopies are a valuable tool towards this purpose. The use of FTIR to perform this diagnosis limits the substrates upon which the analysis can be performed. On the other hand, Raman spectroscopy allows one to observe films on substrates that are not IR transparent. The aim of this paper is to take advantage of the different absorption/scattering cross sections of the two techniques in an effort to understand the origin of various peaks and provide useful information about the properties of the film. We will address some classical subjects related to the structure and dynamics of hydrogenated microcrystalline silicon and provide advances on their comprehensive understanding. We review the current methods for the calculation of film crystallinity and discuss our critical approach to the use of Raman spectroscopy in the context of crystallization kinetics of films deposited on different type of substrates with structures ranging from pure amorphous to highly crystalline. Furthermore, special attention will be paid to the distribution of Si-Hx configurations within the film and the contribution of structural defects on the crystallization transition. These factors are critical and indicative of material that is porous and thus unsuitable for thin-film photovoltaics. A new method for monitoring the dynamics over time of the unintentional oxygen incorporation in the film which affects the material properties is proposed. We discuss our results in the framework of the current phenomenological status of the field for a wide range of films deposited by different Silane-Hydrogen glow discharges at different experimental conditions.

Keywords
microcrystalline silicon
amorphous silicon
microstructure
FTIR-Raman