



Dipartimento di Ingegneria dell'Informazione, Elettronica e Telecomunicazioni

Implementazione della tecnica di surface photovoltage per la caratterizzazione di semiconduttori

Laureando: *Luca Martini*

Relatore: Prof. Rita Asquini

Correlatore: Dr. Ing. Mario Tucci

Abstract:

The thesis resumes the theoretical analysis of surface photovoltage effect, and the development of various experimental setups useful to measure the phenomenon. Once the measurement conditions have been defined, the aforementioned theoretical study has been the base for the selection of the suitable setup; in particular, in this work, a MIS (Metal Insulator Semiconductor) structure has been preferred to a Kelvin Probe configuration. Among the various setups implemented during the thesis, the first allowed to derive the surface photovoltage value by wavelength variations of the light inferring to the sample, while the second setup has been able to measure the maximum value of the surface photovoltage produced changing a bias voltage applied to the sample surface. From data collected by the first setup it was possible to evaluate the diffusion length value of the minority carriers (and hence the life time) within the semiconductor bulk. On the other hand post-elaboration of data arising from the second setup allowed the evaluation of the surface state density within the semiconductor gap. In this work the surface photovoltage transient was also measured in order to evaluate the recombination rate of photo-generated carriers.

Measures were performed mainly on samples of crystalline silicon, paying particular attention on the measure of surface defects density. Indeed this value is strongly related to the surface quality in terms of cleaning procedures and passivation. An interesting and innovative application for these measurement setups was the evaluation of surface defects density of crystalline silicon surfaces once passivated by a hydrogenated amorphous silicon thin film. The setup has been sufficiently sensitive to evaluate the a-Si:H/c-Si heterojunction interface quality and in particular the innovative effect of a hydrogen plasma treatment performed after the deposition of amorphous silicon to enhance the silicon surface passivation quality.

The setups built can now be considered effective tools for surface analysis; indeed they allow to evaluate the effectiveness of cleaning and passivation processes useful for crystalline silicon in photovoltaic applications.