NEUTRON ACTIVATION ANALYSIS IN A SOLAR CELL FABRICATION PROCESS

Stem,N.

Departamento de Engenharia de Sistemas Eletrônicos - Escola Politécnica Universidade de São Paulo Av. Professor Luciano Gualberto, Travessa 3, 158 05508-970 São Paulo, SP nstem@lme.usp.br

Moreira, E. G.

Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP) Av. Professor Lineu Prestes 2242 05508-000 São Paulo, SP emoreira@ipen.br

Cid, M. , Ramos, C. A. S.

Departamento de Engenharia de Sistemas Eletrônicos - Escola Politécnica Universidade de São Paulo Av. Professor Luciano Gualberto, Travessa 3, 158 São Paulo, SP mcid@lme.usp.br, cramos@lme.usp.br

Vasconcellos, M. B,

Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP) Av. Professor Lineu Prestes 2242 05508-000 São Paulo, SP mbvascon@ipen.br

In the last decade the photovoltaic market presented an exponential growth causing an increase in the silicon demand. Silicon solar cells have been obtained in most cases in crystalline wafers, either multicrystalline or monocrystalline. However, the shortage in the silicon feedstock has imposed the necessity of development of new materials such as solar grade silicon (higher impurity concentration) and of improvement of the fabrication process technology, becoming imperative the development of initial material characterization techniques. In this work, samples of FZ silicon with 25 Ohm.cm resistivity were characterized just after two steps of the solar cell fabrication process: the initial cleaning and oxidation using three different techniques of analysis: Photoconductive Decay (PCD), Secondary Ion Mass Spectroscopy (SIMS) and Instrumental Neutron Activation (INAA). The elements As, Br, Ca, Co, Cr, Fe, K, Na, Se, W and Zn were investigated as trace impurities in FZ silicon, before and after the thermal treatment typically used for solar cell fabrication. The PCD technique characterization allowed to qualify the bulk lifetime of oxidized samples, at about 1ms and the surface recombination surface velocity, at about 10.8 cm/s, showing the good quality of the initial material and the obtained passivation layer. The SIMS profiles of the remaining impurities after chemical cleaning presented depths lower than 2.0 microns, indicating that the impurity traces almost do not damage the bulk lifetime in agreement with the PCD results. In sequence, the INAA characterization showed that the impurity concentrations were kept practically the same just after cleaning and just after oxidation, corroborating the found results of the PCD and SIMS characterizations, and therefore, showing the suitability of the application of INAA, a nuclear analytical technique, which allows a qualitative monitoring of a solar cell fabrication step. Despite, the impurities in the FZ-Si samples have been analyzed only qualitatively by the INAA, it would be possible to determine the impurities by changing the experimental conditions such as use of longer irradiation periods and gamma ray detectors of higher efficiency.