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GROM / Thin films growth and modelling

Optimization of the anti-reflective coating (SiC_XN_YH) / Silicon interface to improve silicon photovoltaic cell performance

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Abstract content

Thin dielectric films are nowadays widely used in the photovoltaic field (PV), for which both passivation of surfaces and anti-reflective properties are sought. Hydrogenated silicon carbonitride thin films (a-SiC_xN_y:H) recently attracted great interest because of their physico-chemical intermediate of those of silicon carbide (SiC) and silicon nitride (Si_3N_4). The most useful behavior concerns the optical constant tunability of a-SiC_xN_y:H films which are promising as antireflective coatings for silicon photovoltaic cells. However, the interface between the Si substrate and antireflective films plays a key role on the yield of PV cells. Thus, a surface passivation method, consisting of a nitridation process performed using N_2 plasma (ECR and GDS) sources implemented in an ultra-high vacuum chamber, was set up. This aims to minimize the dangling bonds and therefore to reduce the interface state density. Various experimental parameters (substrate temperature, nitridation time, N_2 pressure, substrate crystallographic orientation) have been varied to create a very thin SiN film (less than 10 nm) studied by X-ray Photoelectron Spectroscopy measurements combined with surface models which allow the determination of the composition and the thickness of the nitride layer formed. Having optimized the SiN layer structure, a-SiC_xN_y:H film is elaborated by a reactive deposition process using non-toxic gases (CH_4, N_2, O_2) involving radio-frequency plasma. Electrical measurements were carried out to estimate the improvement of the elaborated interface.

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