Molecular Electronic Structure at Troy, Çanakkale, TURKEY

9-12 Sept. 2012

Influence of Silicon Dioxide SiO_2 Molecules on Emitter Formation During the Industrial Crystalline Silicon Solar Cells Manufacturing

Hocine Ghembaza[1], Abdellatif Zerga[1] and Rachid Saïm[2]

[1] Materials and Renewable Energies Research Unit (URMER), Tlemcen University, PO Box 119, 13000 Tlemcen, Algeria
e-mail: hocineghembaza@gmail.com
[2] Laboratoire Energétique et Thermique Appliquée (ETAP), Tlemcen University, PO Box 230, 13000 Tlemcen, Algeria

Abstract

Actually, during emitter formation in crystalline silicon solar cells manufacturing and at high concentrations of $POCl_3$, precipitates are formed on the wafer's surface and promote the existence of electrically inactive phosphorus which forms a so called: Dead layer at the silicon surface characterized by a kink shape on the experimental profiles. On the other hand, high concentration of phosphorus atoms causes an important degradation in the Internal Quantum Efficiency especially at the short wavelength region. Some manufacturers tried to reduce the thickness of the dead zone by an additional step in the industrial process: acidic chemical etching of Phospho-Silicate Glass after the phosphorus diffusion but this solution increase the duration of industrial process and it appears expensive.

In the present paper, we propose a low cost method to reduce the dead layer based on the work of Cuevas et al. [1] and reported by [2-4]; they demonstrate a strong influence between the kink shape of diffusion profile and emitter sheet resistance.

Our technique is construct on the basis of the principle that oxidation enhance phosphorus diffusion [5-6]. This method has an objective to decrease inactive phosphorus by an additional oxidation step before phosphorus diffusion. Graphically this implies the reduction of the plateau width which appears on the top of diffusion profiles near the high phosphorus concentration zone (cf. Figure 1).

In a first result, we can demonstrate by introducing a thin SiO_2 layer like a barrier for phosphorus diffusion that the dopants concentration has decreased for a standard sheet resistance (40 Ω/sq), implying a reduction in profile plateau width. A value of about 80 nm was found and it appears the optimum for dead layer reduction.