Nano Structured Silicon as Antireflection and Emitter for Terrestrial Solar Cells

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Abstract

The demand for renewable energy has increased in the last few years due to the limited availability of the widely used fossil fuel. Solar energy is by far the most abundant renewable energy source available, but the levelized cost of solar energy is still not competitive with that of fossil fuels. Therefore, there is a need to improve the power conversion efficiency of solar cells without increasing the production cost. A big challenge is to reduce the cost via utilizing the cheapest materials with high thorough put is essential. The lecture will cover the main objective to develop nanostructured silicon (Si) solar cells with higher power conversion efficiency using scalable and cost-efficient production methods. The nanostructures are fabricated by simple maskless single-step electrochemical and two-step metal assisted chemical etching (MACE). Currently, electronic grade silicon wafers has been widely used for the preparation of porous silicon (PS) layers in decades. In our work, we have made an attempt to employ cheaper upgraded metallurgical grade (UMG) wafers replacing the expensive electronic grade and fabricated the PS layers with Si nanostructure as observed from the SEM images shown in Fig 1. In general, the optimization was done through varying the parameters like etching time, electrolyte concentration, current density for the electrochemical etching and the metal concentration & etching time for MACE process. For the first time, in-house low temperature and high pressure setup was utilized to passivate the active PS layer. The details of the optical and structural properties shall be elaborately discussed with the necessary experimental methods. Finally, a solar cell device was fabricated using the PS layer and subjected to solar cell testing.

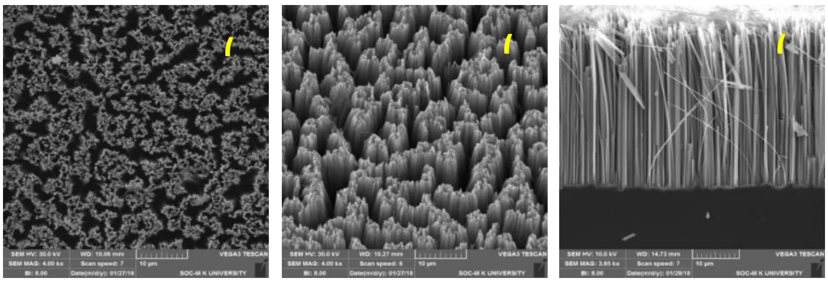

Fig. 1: SEM images of Si nanostructure by MACE a) top view, b) 20^{o} tilted view, c) cross section.