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Synthesis, Opto-structural and Electrical Characterisations of Nd2O3-coated Silicon Nanoparticles

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Silicon nanoparticles of 2-10 nm size (Si-np) embedded into silicon nitride (Si3N4) thin films (70 nm thick) were synthesized and deposited on polycrystalline silicon wafers through plasma enhanced chemical vapour deposition (PECVD) technique using ammonia (NH3) and silane (SiH4) as precursor reacting gases. A second layer (50 nm) consisting of rare-earth neodymium oxide (Nd2O3) was added onto the Si-np by thermal evaporation. The resulting samples consisting of bilayered coating on Si substrate were assumed to possess photoluminescent properties where Nd2O3 and Si-np elements “cooperate” to emit a stronger signal. The occurrence on the wafer’s surface of Si-np differing in size and the formation of the Nd2O3 layer were supported by atomic force microscopy (AFM) and scanning electron microscopy (SEM). Chemical composition characterisation was done by X-ray photoelectron spectroscopy (XPS) and energy dispersive x-ray spectroscopy (EDS). The devices were finalised by screen-printing the contacts (Ag-Al) on the front face and Al on the rear. Electrical measurements by Hall effect and spectral response were carried out to determine carrier concentrations, mobility of the charge carriers and efficiency of the obtained solar cells.

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