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Nanotextures for crystalline silicon solar cells

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Surface texturization is used to improve the solar cells performance. There are three major objectives for texturing the surface of a solar cell: (1) front surface reflectance reduction; (2) enhancement of the light path length through the cell, and (3) increasing the amount of trapped light reflected from the back surface.

Various nanoscale textures are formed on photovoltaics grade silicon (monocrystalline and multicrystalline) surfaces by using a two-step wet- chemical method consisting of an electroless treatment in activated persulfate solution for localized oxidation/surface reaction and oxidation/ reaction products etching in an aqueous solution of HF and H_2O_2 assisted by the presence of silver nanoparticles. The reflectance of the nanotextured Si wafer surfaces less than 5% in the spectral interval 300-900 nm is observed. It was found that the surface texture can withstand without significantly changing the high-temperature solar cell processing. Nanotextured c- Si and mc-Si solar cells are prepared using the standard screen printing technique. Weighted reflectance and I-V characteristics are measured and compared to those of standard cells.

Further crystalline silicon solar cells with two-scale texture consisting of random upright pyramids and surface nanotextured layer directly onto the pyramids are prepared and reflectance properties and I-V characteristics measured. The micro/nano texture is found to lower considerably the light reflectance of silicon. The short wavelength spectral response (blue response) improvement is observed in micro/nano textured solar cells compared to to standard upright pyramids textured cells.

A method of crystalline silicon surface isotropic texturing with random inverted pyramidal structures is moreover provided. The method is based on a sequence of electroless wet-chemical treatments in basic and acidic solutions as well as strong oxidant containing solutions. The method is completely non-lithographic and mask-less suitable for industrial mass-production of solar cells.

Keywords: nanotexture; silicon; solar cell; electroless etching