Study of p-type macroporous silicon and application to multicrystalline silicon solar cells.

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The main goal of this work consisted in the formation of macropores on the surface of multicrystalline silicon with a resistivity between 0.2 and 2 Ω.cm, which is used in the fabrication of solar cells. First, we studied the conditions of formation of macropores on monocrystalline p-type silicon of the same resistivity. We found that macropores can only be formed when electrolytes containing mixtures of HF with specific organic solvents were used.
In order to gain information about the dissolution mechanism, in-situ measurements of surface photovoltage and photoluminescence at the silicon/electrolyte interface were performed during the dissolution. The photoluminescence shows that the surface is well passivated in the region of porous silicon formation. From the measurement of the photovoltage at the rest potential and under anodization, it can be concluded that the silicon is depleted.
The conditions for macropore formation were optimized and applied to the Polix multicrystalline silicon. The resulting surfaces exhibit a very low reflectivity (~ 10%). Next, macroporous texturized solar cells were made by the industrial standard processing of Photowatt. The solar cells show an increased efficiency (13.3% compared to 12.5% cell average efficiency of the polished reference cells). The internal quantum efficiency of the macroporous texturized silicon solar cells is increased at long wavelength compared to the reference cells, probably due to light trapping.