

Noble metal catalytic etching 방법으로 제조한 실리콘 마이크로와이어 태양전지

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The Si Microwire Solar Cell Fabricated by Noble Metal Catalytic Etching

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Abstract : A photovoltaic device consisting of arrays of radial p-n junction wires enables a decoupling of the requirements for light absorption and carrier extraction into orthogonal spatial directions. Each individual p-n junction wire in the cell is long in the direction of incident light, allowing for effective light absorption, but thin in orthogonal direction, allowing for effective carrier collection. To fabricate radial p-n junction solar cells, p or n-type vertical Si wire cores need to be produced. The majority of Si wires are produced by the vapor-liquid-solid (VLS) method. But contamination of the Si wires by metallic impurities such as Au, which is used for metal catalyst in the VLS technique, results in reduction of conversion efficiency of solar cells. To overcome impurity issue, top-down methods like noble metal catalytic etching is an excellent candidate.

We used noble metal catalytic etching methods to make Si wire arrays. The used noble metal is two; Au and Pt. The method is noble metal deposition on photolithographically defined Si surface by sputtering and then etching in various BOE and H₂O₂ solutions. The Si substrates were p-type (10 ~ 20 ohm·cm). The areas that noble metal was not deposited due to photo resist covering were not etched in noble metal catalytic etching. The Si wires of several tens of μm in height were formed in uncovered areas by photo resist. The side surface of Si wires was very rough. When the distance of Si wires is longer than diameter of that Si nanowires are formed between Si wires. These Si nanowires can be removed by immersing the specimen in KOH solution. The optimum noble metal thickness exists for Si wires fabrication. The thicker or the thinner noble metal than the optimum thickness could not show well defined Si wire arrays.

The solution composition observed in the highest etching rate was BOE(16.3ml)/H₂O₂(0.44M) in Au assisted chemical etching method. The morphology difference was compared between Au and Pt metal assisted chemical etching. The efficiencies of radial p-n junction solar cells made of the Si wire arrays were also measured.