Synthesis of CIS Nanoparticles through Chemical Reactions in Aqueous Solution

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Among the various solar cells, CIS ($CuInSe_2$) type solar cell shows attractive performance, it can also be produced lower cost than Si solar cell. The current main manufacturing method for CIS and CIGS type solar cell is by gas phase method. However, since vaporizing temperature of four elements is extremely different, productivity under the gas phase is relatively low, which translates as a large amount of waste of resources. Thus, to decrease the cost of CIS type solar cell, synthesis method with high recovery rate should be developed.

So, we tried to synthesis CI nanoparticles in aqueous solution by reducing copper and/or indium metal homogeneous complexes with similar reduction potentials. From these nanoparticles, a CIS solar cell was successfully manufactured by spin coating of the nanoparticles and subsequent selenization with H_2Se gas at 575ºC. Thus, these results means that synthesis of CIS nanoparticles in aqueous solution lead the low energy fabrication of printable CIS solar cell. The goal of this experiment is to remove the selenization/sulfurization step in the gas phase completely by carrying out that step in aqueous solution, and manufacture CIS solar cell by printing method.

At the first step, CI nanoparticles will be synthesized in aqueous solution by reducing copper and/or indium metal homogeneous complexes in an aqueous solution. The CI nanoparticles obtained are then filtered and dried. In order to change the CI nanoparticles into CIS nanoparticles, the CI nanoparticles will be reacted with S^{2-} ions using Na_2S solution. The concentration of the Na_2S solution, the reaction temperature, and the reaction time was used as the reaction parameters as follows, The concentration of Na_2S will be varied as 0.1, 0.3, and 0.5 M. The reaction temperature will be varied at 30, 50, and 70ºC and the reaction time will be varied at 1 hour and 2 hours. Figure 1 shows the SEM images of CI films on the substrate. Relatively flat CI precursor film were successfully synthesized by using these particles. The particles reacted in the Na_2S will later be characterized by X-Ray Diffraction to determine whether the target material, CIS, is synthesized. The particles will also be characterized by SEM to determine its morphology and EDX to determine the elements in the particles. Other results will reported in our presentation.

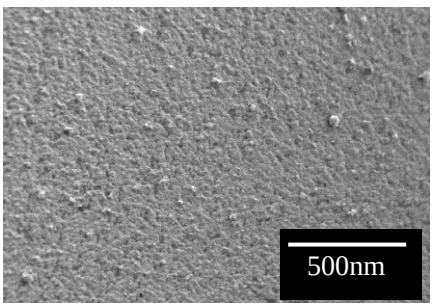

Fig.1 SEM images of CI films on the substrate

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