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Silicon-based layers: experimental study and applications

by

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Solar energy is the most promising renewable energy source for the replacement of fossil fuels. The need for the sustainable energy sources has led to innovative methods and highly efficient materials to improve the performance and stability of photovoltaic devices. The fabrication of silicon-based devices with high power conversion efficiency has still attracted great attention in the past years.

In this talk, I will present our research in preparation and characterization of silicon-based thin films and their using in solar cells. Firstly, I will mention investigation of single layers. Hydrogenated thin silicon nitride (*a*-SiN_x:H) films were deposited at various nitrogen and silane gas flow ratios, while nanocrystalline silicon (*nc*-Si:H) films were deposited from gas mixture of hydrogen and silane. These silicon-based thin-film alloys are materials of considerable interest and have been studied extensively by the scientific community for a wide range of applications, including microelectronics, photovoltaics and photonics.

Secondly, I will describe formation and description of silicon nanostructures embedded in silicon nitride multilayered structures with different thickness of sublayers. When silicon is made very small in one or more dimensions, quantum confinement cause its effective band-gap to increase. The band-gaps of individual cells in the tandem solar cells may be tuned by adjusting the silicon QD (quantum dot) size. If these QD are spaced close together, carriers can tunnel between them to produce conducting quantum dot superlattices. These structures then could be used as a material for the higher band-gap cells.

The last part of my talk will be dedicated to fabrication of solar cells. The first type of cell is based on Si wafer with molybdenum trioxide (MoO_3) front window layer. In this contribution, MoO_3 thin-film was investigated and used as an effective hole injection layer in silicon heterojunction solar cells. In the next case, I will report the fabrication and characterization of p-i-n single junction silicon thin film solar cells continuously grown in a conventional cluster-type five-chamber tool PECVD system. The effects of p-type window layers and different TCO substrates on solar cell performance parameters were investigated.

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