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Influence of Quantum Dots and Surface Nanotexturization on Solar-Cell Performance

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The utilization of nanoparticles in combination with a photon capture scheme and selected thin-films, has enabled the demonstration of photovoltaic structures on single-crystal silicon substrates with an efficiency of 13.3%. Hybrid solar-cells have also been considered as an alternative to develop cost-effective photovoltaic devices because the Schottky-union between organic and inorganic materials can be formed employing low-temperatures fabrication methods. We describe a hybrid solar-cell based on an ordered array of silicon-nanopillars and the conductive polymer PEDOT:PSS. The performance characteristics of the produced solar-cells was analyzed in function of nanopillar height. A maximum power conversion efficiency of 9.65% was observed for an optimized height of 400 nm. The effect of ultrathin films of Al_2O_3 realized employing an atomic-layer-deposition tool was also included in this study and its utilization further increased the measured efficiency to 10.56%. The utilization of nanostar alloys enabled reaching an efficiency of 13.3%. Intending to lower the cost of solar-cell manufacturing, additional tests have been carried out on structures with a total thickness <20 μm. The discussed structures are considered promising towards the realization of high-efficiency solar-cells.