Emerging photovoltaic technologies seek to push the boundaries of both efficiency and cost-effectiveness through the use of flexible platforms and novel material systems. My talk will primarily focus on Colloidal quantum dots and Semiconducting single-walled carbon nanotubes in photovoltaic applications. Colloidal quantum dots (CQDs) are nanometer scaled semiconductor crystals that are synthesized in, processed with, and deposited from solution. These materials offer a new paradigm for optoelectronics; one in which materials properties are not strictly material dependent, but are also influenced by physical dimension. With CQDs, optical absorption ranges can be tuned by adjusting the size of the nanoparticles on the Angstrom length scale. For photovoltaics, this enables facile access to much broader range of the Sun's spectrum than is accessible through conventional photovoltaic materials such as silicon and gallium arsenide. The second part of my talk will focus on the emerging field of single-walled carbon nanotubes (SWNTs) photovoltaics. SWNTs are typically synthesized as a mixture of chiralities, with one-third of the mixture being metallic and the remaining two-third being semiconducting. We developed a polymer sorting strategy to selectively disperse semiconducting small diameter carbon nanotubes viable for the active layer of the solar cell. In fact, SWNTs, in similar fashion to CQDs, possess the quantum tuning effect where smaller diameter tubes correspond to larger bandgaps. Working with CQDs and SWNTs, however, is not without its challenges. These materials demand additional considerations that need to be taken into account when developing solar cell architectures. Architectural and material considerations include issues such as chemical compatibility, energy level matching, processing limitations and materials selection. Taken together, these dictate how to develop solar cells that highlight the potential of quantum-tuned nanomaterials as solar harvesters while limiting their flaws.