Towards High Efficiency Photovoltaic Devices

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The efficiency of photovoltaic devices has been steadily increasing over the course of the past two decades. However, a fundamental thermodynamic limit, the Scockley-Queisser (SQ) limit of approximately 31% for single junction solar cells limits the potential performance of these devices. This limit arises from energy losses in photovoltaic devices due to carrier thermalization and optical transparency. In this talk I will discuss our recent work towards overcoming the SQ limit by utilizing two approaches: carrier multiplication and sequential light absorption. Carrier multiplication occurs in diketopyrrolopyrrole (DPP) based dyes, which are air stable molecules capable of undergoing singlet fission of excitons. Sequential light absorption occurs in Intermediate Band Solar Cell based Type-II ZnCdSe/ZnCdTe quantum dots. Both of these systems are promising candidates for realizing high efficiency photovoltaics capable of outperforming the SQ limit and potentially realizing high efficiency solar cells.