**Advanced Organic Molecules for New Generation Solar Cells**

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The application of solar cells is one of the most promising solutions for satisfying the ever-increasing global energy demand. First generation (1G) solar cells contain silicon wafers, which, although having high efficiency, are expensive to produce. Second-generation thin-film solar cells contain a layer of amorphous silica; however, their performances are poorer than their 1G counterparts. Hence after two decades of research, efforts are now centered on the development of a third generation (3G) of newly emerging solar cells. 3G solar cells include copper/zinc/tin sulfide solar cells, dye-sensitized solar cells (DSSCs), organic solar cells, polymer solar cells, quantum dot (QD) solar cells, and perovskite solar cells (PSCs). Recently, organic-inorganic hybrid lead halide PSCs are gathering attention and have emerged as an extremely promising photovoltaic technology due to their remarkable photovoltaic performance and potentially low production cost. To date, progress has been made on each layer, with major emphasis on perovskite film processing and relevant material design. Consequently, the power conversion efficiency of lead halide perovskite based thin film photovoltaic devices has skyrocketed from 3.8% to 25.8% in just ten years [1].

Despite significant efforts dedicated towards development of new hole transporting materials (HTMs) the field is still dominated by 2,2`,7,7`-tetrakis(*N*,*N*-di-*p*-methoxyphenylamine)-9,9`-spirobifluorene (Spiro-OMeTAD) [2]. This compound combines high solubility, good film-forming ability, and suitable frontier molecular orbitals energy levels, resulting in excellent performance and ease of use [3]. However, the synthesis of Spiro-OMeTAD is expensive and its purification is tedious, which limits its application to the large-scale fabrication of PSCs [4]. Although many HTMs with comparable performance to Spiro-OMeTAD have been reported, multistep synthetic procedures are still required in most cases. More work is therefore needed to develop truly low-cost and efficient HTMs needed for the commercialization of PSCs.

This lecture will cover results of our recent investigations in the field of molecular engineering of small molecule hole transporting materials for perovskite solar cells. Our group has been successful in creating several classes of novel organic charge transporting materials, which are on a par with or even better than Spiro-OMeTAD. The molecularly engineered new hole transporting materials were synthesized in one or two steps from commercially available and relatively inexpensive starting reagents, resulting in up to several fold cost reduction of the final product compared with Spiro-OMeTAD. High solubility in organic solvents and ease of preparation makes these molecules very appealing for commercial prospects of photovoltaic devices.

**References**

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