

## ORGANIC SOLAR CELLS UTILIZING NON-PERIPHERAL OCTAHEXYLPHTHALOCYANINE AND ITS ANALOGUES

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Non-peripherally alkyl-substituted phthalocyanines, such as, 1,4,8,11,15,18,22,25-octahexylphthalocyanine (C6PcH<sub>2</sub>), which possesses excellent properties, such as, high carrier mobility comparable to that of a-Si (1.4 cm<sup>2</sup>/Vs), are low-molecular-weight organic semiconductor, and has high solubility in typical organic solvents due to the long substituents. C6PcH<sub>2</sub> also exhibits liquid crystalline phase, such as, hexagonal disordered columnar mesophase between 161 and 170 °C, therefore, it is one of the liquid crystal organic semiconductors.

Here, we report on solution processed small-molecule based organic solar cells (OSCs) utilizing C6PcH<sub>2</sub> and its analogue molecules, like phthalocyanine-tetrabenzoporphyrin hybrid macrocycles with alkyl-substituents at non-peripheral positions. By replacement of aza links at meso position in phthalocyanine core by methine groups, the optical absorption at B band of porphyrinoid complexes is enhanced, the energy bandgap is enlarged, and the packing structure of the discotic molecules changes. By controlling the numbers of aza links at meso position, that is, the energy diagram could be tuned, resulting in the modification of the electronic properties.

Utilizing the series of phthalocyanine-tetrabenzoporphyrin hybrid macrocycles as donor molecules in an active layer of bulk-heterojunction solar cells involving with a nanoscale phase separation, which could be fabricated by wet process, the photovoltaic properties depending on the number of methine groups could be obtained. In the case of solar cells with nonperipherally substituted octahexyltetrabenzotriazaporphyrin (C6TBTAPH<sub>2</sub>), the external quantum efficiency at B band and power conversion efficiency are improved comparing with those with C6PcH<sub>2</sub>, resulting in 53% and 5.3%, respectively. The mechanism of the photovoltaic properties is discussed by taking the molecular packing structure in bulk heterojunction film and the charge transport properties into consideration.

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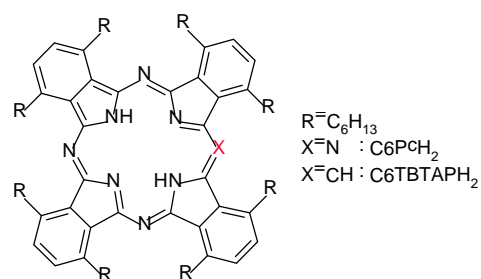


Figure 1: Molecular structures of C6PcH<sub>2</sub> and C6TBTAPH<sub>2</sub>