

# High-Rate Nanoimprinting of Photoactive Rosette Nanotube-Based Organic Solar Cells\*

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Due to their cost effective and flexible nature, organic photovoltaics are considered as a new and viable alternative for the silicon-based solar cells. However, organic solar cells suffer from poor power conversion efficiency (PCE) due to their low conductivity and narrow absorption spectral range. A wide variety of research has been invested in order to improve the PCE, which depends on different factors such as the morphology of the photoactive materials used, structure of the cells, and fabrication techniques. For instance, the structure of the cell has been altered by introducing hetero-junction, multi-junction and tandem solar cells. Photoactive materials generally display intense and broad absorption band as well as moderate charge carrier mobility. Since highly ordered nanoscale morphologies of the bulk hetero-junction layers are ideal for the development of high efficient organic photovoltaics, self-assembly is an obvious and attractive pathway to introduce order from the nanoscale to the macroscale to shape the nanoscale morphology of photoactive molecules.

Self-assembled rosette nanotube, invented by Fenniri *et al.*,<sup>1</sup> are thermodynamically stable structures that can self-organize with porphyrin and/or oligothiophene as electron donor and acceptor groups on their outer surface.<sup>2</sup> These self-assembled nanotubes have a great potential for application in organic solar cells.

Nanoimprinting drew a lot of interest as a new fabrication method by providing highly organized molecular morphology and enhanced charge carrier properties. In recent years, power conversion efficiency of 10% has been achieved by organic solar cells manufactured with printing methods. Busnaina *et al.*, invented a unique high-rate offset nanoimprinting technique,<sup>3</sup> which enables manufacturing of highly oriented nanoparticles on a polymer substrate employing dielectrophoresis assembly on a damascene template. Electron transfer rate has been enhanced as a result of nanotube alignment followed by high conductivity of manufactured device which turns nanoimprinting, as future path to the fabrication of organic photovoltaics.

In the current study, we will use offset nanoprinting technique to fabricate an organic solar cell based on photoactive rosette nanotubes. By designing a damascene template in this study, porphyrin-based and/or oligothiophene-based rosette nanotubes with highly aligned structure will be assembled on the template and then printed on a polymer substrate. We anticipate enhancement in the power conversion efficiency of manufactured organic solar cells consisting of oriented rosette nanotubes.

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