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Thesis Outline

Solar Steam Generation Properties of Donor-Acceptor Molecules and Polymers

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In Chapter I, the research background of solar steam generation (SSG) was introduced. Additionally, the commonly used photothermal materials (PTMs) for SSG and the device structures for enhancing SSG efficiency were comprehensively introduced.

In Chapter II, dithienoindacenodithiophene (DTIDT) small molecules were synthesized and post-functionalized by [2+2] cycloaddition-retroelectrocyclization (CA-RE) reactions. The synthesized molecules were characterized by ^{1}H-NMR, ^{13}C-NMR, FTIR, and MALDI-TOF MS. Thermal stability, optical properties, and electrochemical properties were investigated by thermogravimetric analysis, UV-VIS-NIR absorption and photoluminescence (PL) spectra, and cyclic voltammetry measurements. Due to the intramolecular charge transfer, the post-functionalized derivatives showed broader optical absorption range and weaker PL properties. The synthesized molecules were casted on commercially available filter papers as photothermal membranes for the evaluation of SSG properties. The membranes exhibited a Janus structure with the hydrophobic top side and hydrophilic bottom side. The hydrophobic top layer prevented excessive water accumulation, minimized unnecessary heat loss while the hydrophilic bottom layer facilitated rapid and continuous water transport. SSG properties of the photothermal membranes under simulated sunlight irradiation were monitored using an infrared camera and a weight

balance. Due to the higher absorption and lower PL properties, photothermal membranes with post-functional molecules exhibited higher surface temperatures and SSG efficiencies.

In Chapter III, polymers composed of vNDI-based dual acceptor (donor-acceptor1-donor-acceptor2) structures were applied as PTMs in SSG research. Different acceptor units were employed to tune intrachain charge transfer, broaden the optical absorption spectra, and improve photothermal properties. The membrane preparation and SSG measurement method are the same as those in Chapter II. The result suggested that stronger acceptor2 units in the polymer chain exhibit a better photothermal property and SSG efficiency.

In Chapter IV, the research achievements are summarized and future prospects are discussed.