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Diels-Alder Strategy for the Organic Semiconductor Pentacene

E. M. Ko, D. H. Ryu

Department of Chemistry, Sungkyunkwan University

Organic semiconductors have attracted considerable attention in the past two decades as progress in the fields of organic photonics and electronics has led to applications of organic light-emitting diodes, field-effect transistors and photovoltaic cells. Organic thin film transistors(OTFTs) based on vacuum deposited organic semiconductors have exhibited field-effect mobilities similar to that of amorphous silicon TFTs.

Pentacene has been the subject of special attention due to the combination of its commercial availability, device performance and environmental stability and is a possible candidate to complement or replace the entrenched amorphous silicon technology in many large-area electronics applications. OTFTs comprising vacuum-deposited thin films of pentacene have been reported by numerous group and provide p-type semiconducting channels and field-effect carrier mobilities exceeding $1cm^2V^{-1}s^{-1}$. However, for pentacene or any other organic semiconductors to be commercially competitive, inexpensive, solution-based techniques such as spin coating, dip coating, solution casting, and printing must be employed. One approach to solution processable organic semiconductors has been the use of a soluble precursor of the semiconducting compound to form a thin film, followed by conversion to the insoluble semiconducting form, usually by heating elevated temperatures.

Diels-Alder Reaction, [4+2] cycloaddition has been used as a powerful strategy for the synthesis of useful organic materials. Recently, these methods were applied for the preparation of pentacene precursors in the field of organic thin OTFTs. Since this reaction is reversible the precursor could be converted to pentacene by heating at high temperature. We will describe the preparation of soluble precursors for the organic semiconductor pentacene by using Diels-Alder strategy and its use in the solution-based fabrication of high-performance organic thin film transistors.