MRM2021 Materials Research Meeting
December 13-17, 2021, Yokohama, Japan

Enabling Elastic Semiconductor Structures for Flexible Electronics by Molecular Design and Film Morphology Tuning

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Keywords: Organic semiconductors, metal oxides, thin-film transistors, circuits, stretchable

Organic electronics is a technology enabling the fabrication of mechanically flexible/stretchable electronic circuits and devices using low-temperature, possibly additive, processing methodologies. In this presentation we report the development of novel semiconductors, as well as thin-film engineering, for flexible and stretchable organic and inorganic thin-film transistors, electrochemical transistors, electrolyte transistors and circuits. In particular we show that "ultra-soft" polymers comprising naphthalenediimide units co-polymerized with "rigid" and "flexible" organic units can change how charge transport is affected by mechanical stress, demonstrating that polymer backbone composition is more important then film degree of texturing. Furthermore, molecular design of polymers enables plasticization of small molecule semiconductor used in thin-film transistors. Finally, we report new "soft" transistor architectures using porosity or fibers as key element enhancing mechanical flexibility and tune charge transport. The resulting devices can better sustain mechanical stress, sense analytes, intercalate ions, and be chemically doped.

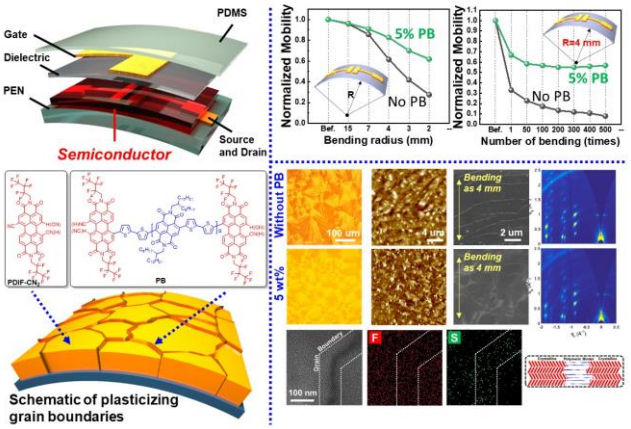

Fig. 1. Mechanical flexibility achieved vis grain boundaries plasticization.

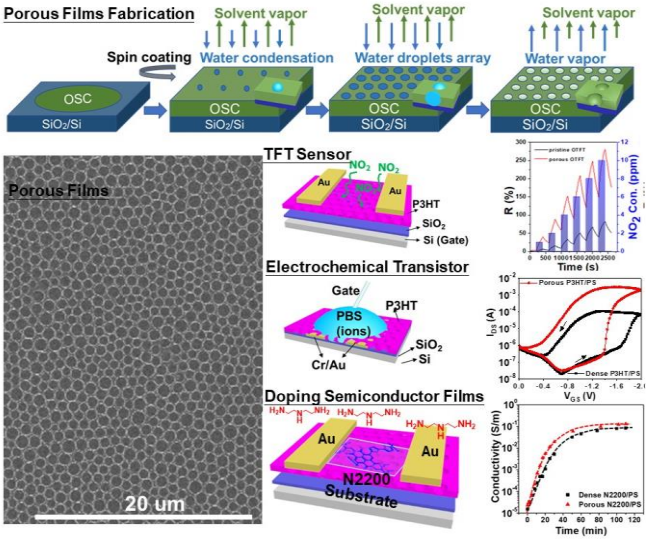

Figure 2. Fabrication and properties of porous and stretchable organic films.

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