The Electronic Structure of Semiconducting Polymer Field Effect transistors with Mobility Approaching 100 cm² /V-s

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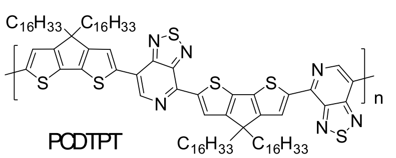
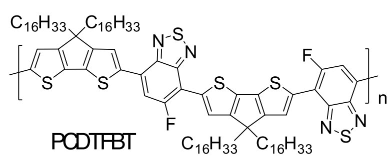
Abstract

The Field Effect Transistor (FET) is an electronic switch. The mobility (μ) of the electrons (n-type FET) or holes (p-type FET) defines how much current passing through the channel (width W, length L_c) can be switched by the FET and how fast that current can be turned on or off. Mobility is therefore the “Figure of Merit” for utility of polymer-based FETs in applications. The transistor is the circuit element that enabled modern electronics. Although FETs fabricated from semiconducting polymers were first demonstrated more than twenty years ago, μ was far too small to be useful in technology. Over many years, the mobilities have gradually increased to values approaching that of amorphous Si (~ 1 cm²/Vs). Many thought that research toward high mobility polymer-based FETs was a hopeless quest.

I will discuss our recent ARPES studies of the electronic structure (band structure and effective mass --- $m^* = 0.1\ m_e$) of high mobility semiconducting polymer thin film FETs fabricated with PCDTBT and its fluorinated derivative, PCDTFBT in the FET channel.





A shown in Fig 2 when deposited from solution, the polymer chains can be oriented and aligned within nano-grooves patterned into the substrate (see Fig 3).