Carrier mobility of conductive polymer studied by Hall-effect measurement

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Recent years have seen tremendous research efforts in developing organic field effect transistors (OFETs). It has always been the technical priority to enhance the device performance in order to increase the switching speed and to lower the operation voltage. One mostly used parameter to assess the device performance is mobility, which is normally extracted from the experimental data of the investigated OFETs. However, there exist several limitations using this method to calculate mobility. First, the mobility could be underestimated due to the significant contact resistance. Second, the extraction could be complicated and human-dependent due to non-linear and non-quadratic transfer characteristics at the linear and saturation regions, respectively. Practically, it is important to have a method that could directly measure the intrinsic mobility. In our work this direct method has been developed using Hall-effect measurement, which allows us to characterize several polymers, for example, polypyrrole (PPy).

A 1cm × 1cm glass substrate was first prepared, on which a 100nm PPy film was then spin coated and dried. Then four contacts were made on the corners of the square substrate using silver epoxy. After that, samples were characterized on Hall effect system using four-probe method. OFETs made of PPy were also prepared for comparison.

The mobility was found to be around 0.30 cm^2/Vs using Hall-effect method and 0.05 cm^2/Vs extracted from the FET data. This is consistent with the above argument that FET's method offers an underestimated value. The Hall effect method eliminates the source of errors and should give a mobility more representing the intrinsic property of the material.