Transmission electron microscopy (TEM) is a unique tool to address fundamental issues regarding the structure and the morphology of electro-active materials used in plastic electronics. Various examples are provided to illustrate recent advances in the understanding of crystallization and structure of conjugated polymers and co-oligomers used as active layers in field effect transistors or organic solar cells. It is demonstrated that low dose TEM operated in bright field, electron diffraction, dark field and high resolution modes provides a new and unique insight into the structure and nano-morphology of key materials used in plastic electronics for the elaboration of electronic devices such as organic solar cells and organic field effect transistors. In particular, we demonstrate the importance of growth control using either epitaxy, high temperature rubbing or other crystallization methods to address properly the structure of conjugated polymers by TEM. Examples concern the polymorphism and nanomorphology of both p- and n-type semiconducting polymers e.g. regioregular poly(3-hexylthiophene) and p(NDI2OD-T2) as well as donor-acceptor co-oligomers used in organic photovoltaic cells. Finally, we show first results on the importance of TEM investigations on the device structure of non volatile memories. More specifically, TEM tomographic investigations and STEM-HAADF investigations on cross sections provide important informations on metal diffusion and nanoparticle distribution in the bulk of polymer layers.

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