

Multilayer polymer light-emitting diodes processed from solution

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At the moment state-of-the-art organic light-emitting diode (OLED) devices consist of a stack of layers of different small molecule-based materials, where the individual layers have specific functions, such as a hole transport layer (HTL), an electron transport layer (ETL) and various emissive layers (EML), i.e. to obtain a white color. The conventional method to deposit such a multilayer stack is by evaporation in a high vacuum tool. The route towards lower cost is to print or coat the layers from solution in a roll-to-roll process. However, the problem with multilayer deposition from solutions is stack integrity: when a second layer is deposited part or most of the first layer will redissolve in the solvent used for the second layer. In this work first the working principle of an organic Led with only one or two printed layers will be evaluated. By looking at the charge transport and recombination processes the loss processes in such an OLED can be determined. From here, also the need for HTL and ETL layer will become clear. As a next step a method to process multilayer OLEDs from solution by separating the solution processing properties of a layer from the active charge transport / emission functionality will be presented. The approach is to develop a generic layer for multilayer OLEDs consisting of an inert host matrix (which is made insoluble after deposition) doped with a functional organic semiconductor. In this way we create layers which do not intermix in a way which does not adversely affect the optoelectronic properties of the layer.