RUPRECHT-KARLS-
UNIVERSITÄT
HEIDELBERG

Colloquium on Advanced Materials

Materials development for full solution processed OLEDs

PD. Dr. Silvia Janietz

Fraunhofer Institute for Applied Polymer Research, Potsdam Golm, Germany

Modern highly efficient organic light emitting diodes (OLEDs), e.g. as employed in mobile phone displays, comprise advanced multi-layer device architectures including functional layers for charge-carrier injection, transport and confinement, commonly being deposited by thermal evaporation in vacuum. With the technology advancing towards larger displays and general lighting, large-area printing and coating techniques are widely considered more facile and cost-efficient fabrication alternatives. To avoid dissolution of previously applied layers during the sequential deposition of multi-layer stacks, orthogonal solvents or crosslinking strategies could be applied. At first a new thermal crosslinking concept is presented and applied to solution processed multilayer OLEDs. The new crosslinking system is based on 1-ethynyl ethers which are bench stable at ambient temperatures but can be fully crosslinked at temperatures of 150°C within minutes. The new crosslinker is introduced in a hole transport layer (HTL) which is solvent-resistant after crosslinking. The HTL is used in first multilayer OLEDs. The OLEDs show efficacies of 100 cd/A. No negative effect of the crosslinker on the device performance was observed[1,2]. In the second part the results will be presented concerning the development of series of side-chain polystyrenes as ambipolar hosts for solution processed OLEDs. The series was derived from the hole-only-transport host molecule 1,3-Bis(N-carbazolyl)benzene (mCP). Electron transport ability was incorporated into the host polymers by the introduction of electron-poor heterocycles (pyridine or triazine)[3]. In the last part of the talk the realization of orthogonal soluble electron transport polymers will be presented. Here the synthesis and characterization of a series of polystyrenes containing phenylpyridine moieties as side-chains are discussed. Methanol solubility of these polymers is induced if the relative pyridine content referred to the overall aromatic units of the side-chains is larger than 0.5. This allows for orthogonal processing of multilayer OLED stacks fabricated from solutions. The polymers show high thermal stability due to their glass transition temperatures ranging from 136 °C up to 247 °C. High triplet energies up to 2.8 eV are obtained by combination of the side-chain aromatic rings in meta-position. The use of the methanol-soluble side-chain polymers as electron-transport layer (ETL) is demonstrated in an orthogonally processed three-layer green-emitting OLED stack. Depositing the ETL from methanol, re-dissolution of the underlying emission layer does not occur[4].

1) T. Schneider, S. Höfle, F. Reisbeck, S. Janietz, A. Colsmann, H. Krüger, F. Limberg, Adv. Funct. Mater. 2016, 26, 8505–8513
2) F. R. P. Limberg, A. Miasojedovas, P. Pingel, F. Reisbeck, S. Janietz, A. P. Monkman, H. Krüger, RSC Adv. 5, 83122–83128 (2015)
3) A. Lorente, P. Pingel, G. Liaptsis, H., S. Janietz, Organic Electronics 41 (2017) 91-99
4) A. Lorente, P. Pingel, A. Miasojedovas, H. Krüger, S. Janietz, ACS Applied Materials & Interfaces, accepted

Date:
20th of July 2017

Time:
17:00 (s.t.)

Place:
Kleiner Hörsaal, Hörsaalzentrum Chemie

Im Neuenheimer Feld 252,
69120 Heidelberg

Web:
www.iap.fraunhofer.de/de/Forschungsbereiche/Funktionale_Polymersysteme/polymere_und_elektronik.html

e-mail:
silvia.janietz@iap.fraunhofer.de

by the

Centre for Advanced Materials

and

Innovation Lab