All-Organic Flexible Field-Effect-Transistors Made of *n*- and *p*-type Highly Anisotropic Semiconductors

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Organic semiconducting crystals showing low or moderate anisotropy of charge carrier mobility are favored for preparation of polycrystalline field-effect-transistors (FETs) since such materials can form continuous conducting paths easier than semiconductors which assemble into segregated anisotropic stacks. On the other hand high charge carrier mobility and high current densities are easier achievable in the quasi-one-dimensional crystals due to strong π - π overlapping caused by the closely packed molecules in the stacks. Since single crystals are difficult to grow and to handle, there was a need to elaborate methods of preparation of large area, ordered and unidirectional oriented layers of organic semiconductors which can be used as the transporting layer in FETs. It was shown, that the zone-casting method is very efficient, continuous technique allowing to grow on SiO_2/Si substrates semiconducting layers with long-range homogeneity, high crystalline ordering and yielding FETs showing good performance [1].

The second challenging problem which has to be solved in order to meet the requirements of the all-organic electronics, is to replace the SiO_2/Si substrates by flexible polymer components. In the present work it is shown, that this goal can be achieved by using a concept of the so called 'reticulate doping' consisting in controlled growth of organic crystals *in situ* in polymer matrix [2]. By using two approaches it is possible to produce from single batch either bilayer composites in which organic crystals form ordered layer on surface of the polymer film (by the so called 'two-step' reticulate doping), or composites where long crystalline whiskers of organic semiconductor grow uniaxially in polymer matrix. In the later case the polymer plays multifunctional role as the dielectric, the support and as the encapsulating coating. Using advantages of this method we have produced OFETs with environmentally sensitive *n*-type perylenediimide derivative, showing high charge-carrier mobility in the range 0.01 – 1 $cm^2/(Vs)$.

This work was supported by project NoE PolyNet UE ICT 214006.

[1] P. Miskiewicz *et al.*, Chem. Mater., 18 (2006) 4724.
[2] J.Ulanski and M. Kryszewski, "Reticulate Composites" in Encyclopedia of Advanced Materials, D. Bloor *et al.*, (Eds.), Pergamon Press, Oxford, 3 **(**1994) 230.