Diploma thesis abstract

«Effect of doping on parameters of organic solar cells»

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In this paper, a numerical study of the effect of doping on basic parameters of organic solar cells is conducted. We developed a numerical model of organic solar cells basing on model, which uses standard approaches for inorganic semiconductor devices. The model was extended by taking into account the doping of active layer and it describes organic solar cells of two types: with bulk heterojunction and bilayer. The numerical modeling was carried out in range of both n-type and p-type dopant concentrations from 0 to 10^{24} m^{-3}.

For optimized bulk heterojunction cell based on the most studied materials (blend of poly-3-hexylthiophene and fullerene derivative PCBM) it was discovered that efficiency decreases from 4.5% to 1% with increase of dopant concentration up to 10^{24} m^{-3} owing to decrease of the short-circuit current and fill factor; the open-circuit voltage changes slightly. However, for non-optimized cell the doping can increase efficiency and other parameters. So, for cases of low charge carrier mobilities, unbalanced mobilities or non-ohmic contacts it was shown, that efficiency can be increased up to four times at dopant concentrations of $10^{23} – 10^{24}$ m^{-3}.

For bilayer organic solar cells we show that the doping of layers by majority carriers increases the short-circuit current, open-circuit voltage, fill factor and efficiency. At dopant concentration of 10^{24} m^{-3} the efficiency increases from 0.25% to 0.86%. In reverse situation, i.e. at doping by minority carriers, the short-circuit current and the open-circuit voltage decreases, also the fill factor significantly decreases and the current-voltage characteristic becomes S-shaped.