Electronic Supporting Information

Side-chain conjugated polymers for the use in the active layers of hybrid semiconducting polymer/quantum dot light emitting diodes

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Monomer characteristics

Figure S 1. $^1$H and $^{13}$C NMR spectra of compound I.
Figure S 2. $^1$H and $^{13}$C NMR spectra of compound 2.
Figure S 3. $^1$H and $^{13}$C NMR spectra of compound 3.
Figure S 4. $^1$H and $^{13}$C NMR spectra of compound 4.
Figure S 5. $^1$H and $^{13}$C NMR spectra of monomer M1.
Figure S 6. $^1$H and $^{13}$C NMR spectra of monomer M2.
Figure S 7. $^1$H and $^{13}$C NMR spectra of compound 5.
Figure S 8. $^1$H and $^{13}$C NMR spectra of compound 6.
Figure S 9. $^1$H and $^{13}$C NMR spectra of compound 7.
Figure S 10. $^1$H and $^{13}$C NMR spectra of compound 8.
Figure S 11. $^1$H and $^{13}$C NMR spectra of monomer M3.
Polymer characteristics

Figure S 12. $^1$H NMR spectrum of polymer P1

Figure S 13. $^1$H NMR spectrum of polymer P2.
Figure S 14. $^1$H NMR spectrum of polymer $P_3$

Figure S 15. $^{19}$F NMR spectrum of polymer a) before and b) after post-polymerization modification reaction. The disappearance of the fluorine atom signals indicates the pentafluorophenyl group replacement with cysteamine methyl disulfide.
Figure S 16. IR spectrum of polymer a) before and b) after post-polymerization modification reaction. The disappearance of the signal at 1772 cm$^{-1}$ (corresponding to CO bond) and appearance of the signal at 1663 cm$^{-1}$ (corresponding to CNH bond) indicates the pentafluorophenyl group replacement with cysteaminemethyl disulfide.

Figure S 17. GPC traces of polymers P1-P3.
Figure S 18. Film absorption spectra of polymers P1-P3. Spin coated from toluene solution.

Figure S 19. Thermal properties of polymers P1-P3. a) Thermogravimetric analysis and b) differential scanning calorimetry with arrows indication glass transition area (inset: enlarged glass transition area of polymer P1).
Figure S 20. Ultraviolet photoelectron spectroscopy (UPS) spectra of polymers P1-P3.

Figure S 21. Cyclic voltammograms of polymer P1 showing the reversible oxidation of the 1\textsuperscript{st} oxidation peak (a) and the irreversible oxidation of the 2\textsuperscript{nd} oxidation peak (b).
**QD characteristics**

Table S1. QD characteristics. a: obtained from TEM images b: Photoluminescence quantum yield (PL QY) was measured using a spectrometer with an integrating sphere (excitation wavelength: 488 nm).

<table>
<thead>
<tr>
<th>Core radius/schell thickness(^a) (nm/nm)</th>
<th>Total radius(^a) (R ± Std, nm)</th>
<th>PL QY(^b) (%)</th>
<th>Ligands</th>
</tr>
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<tbody>
<tr>
<td>2.0/6.3</td>
<td>8.3 ± 0.95</td>
<td>80</td>
<td>Oleic acid</td>
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Figure S 22. a) UV-vis and PL spectra (excitation wavelength 500 nm) in toluene b) TEM image of pristine QDs with oleic acid ligands.
$QD$/Polymer hybrid characteristics

Figure S 23. After the ligand exchange procedure the chemically modified QDs acquire properties (i.e. solubility) of the polymer on their surface. QD/polymer hybrids $QH1$-$QH3$ and pristine QDs dispersed in a) hexane (polymers $P1$-$P3$ are not soluble in hexanes) and b) toluene (polymer $P1$-$P3$ are well soluble in toluene). c) shows two phase system (i) hexanes and (ii) o-dichlorobenzene and the respective solubility of pristine QDs with oleic acid ligands in hexanes and the hybrid $QH2$ in o-dichlorobenzene. In d) hexanes (i) and o-dichlorobenzene (ii) were added to toluene solutions of QD/polymer blend ($QB2$, polymer used is analogues to $P2$, however, it has no disulfide functionality, leading to physical QD/polymer mixture), initial QDs, and QD/$P2$ polymer hybrid $QH2$ (after the ligand exchange procedure). The initial QDs are well soluble in hexanes and only poor soluble in o-dichlorobenzene. The physical mixture of polymer and QDs does not change the solubility of the QDs in $QB2$ and they resume the solubility properties of pristine QDs. The precipitation of the polymer in hexanes can be observed at $QB2$, while QDs remain in the solution. Due to the polymer chains grafted on the surface of QDs in the case of $QH2$, QD in $QH2$ acquire the solubility properties of the polymer used and become
insoluble in hexanes and well soluble in o-dichlorobenzene. e) represents the samples from d after centrifugation at 13000 rpm.

Figure S 24. Film absorption spectra of QD/polymer hybrids QH1-QH3. Spin coated from toluene solution (1 %wt QD, 1 %polymer).

Figure S 25. An example of the influence of chemical grafting of a polymer onto a QD surface. TEM images of spin coated films of a) physically blended QD/polymer P2 solution and b) QH2 QD/polymer hybrid prepared by ligand exchange procedure.
Synthesis of colloidal ZnO nanoparticles

ZnO nanoparticles were synthesized based on low-temperature solution-precipitation method reported in the literature. 3mmol of Zn acetate hydrate was dissolved in 30ml of dimethyl sulfoxide (DMSO). 5mmol of tetramethylammonium hydroxide (TMAH) dissolved in 10 ml of ethanol was dropwisely added in rate of~8ml/min to ZnO solution and stirred 1hr in ambient air. Then ZnO nanoparticles were precipitated with acetone and redispersed in ethanol at a concentration of~40mg/ml.