Supporting Information

A tool-box strategy for layer-by-layer assembly of ultrathin hybrid films from graphene oxide and chromophores for organic electronics

Elizaveta A. Gusarova, Alexandra I. Zvyagina, Alexey E. Aleksandrov, Alexey A. Averin, Alexey R. Tameev, and Maria A. Kalinina*

Frumkin Institute of Physical Chemistry and Electrochemistry RAS, Moscow, Russia 119071

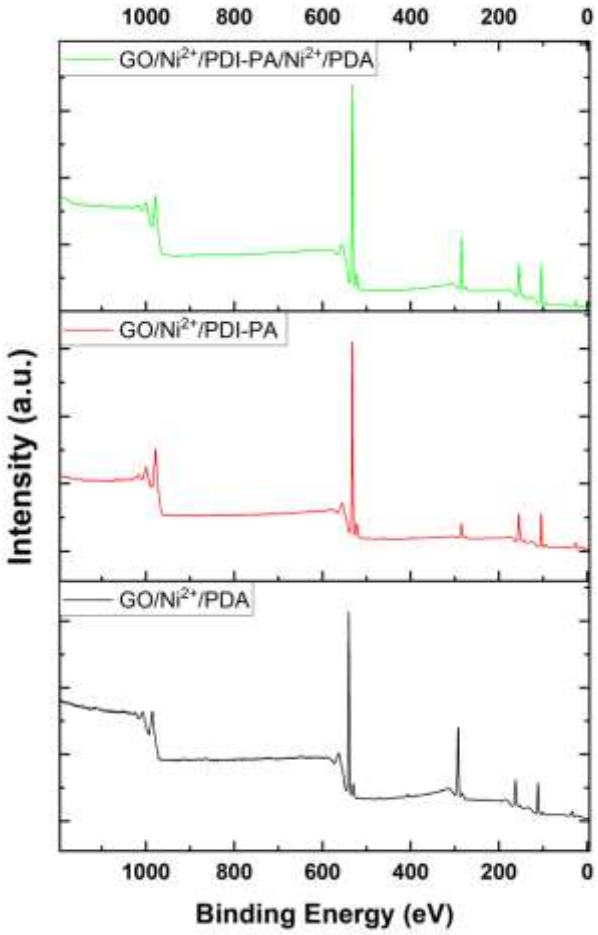

Figure S1. Overview XPS spectra of GO/Ni^{2+}/PDA, GO/Ni^{2+}/PDI-PA and GO/Ni^{2+}/PDI-PA/Ni^{2+}/PDA hybrid materials.

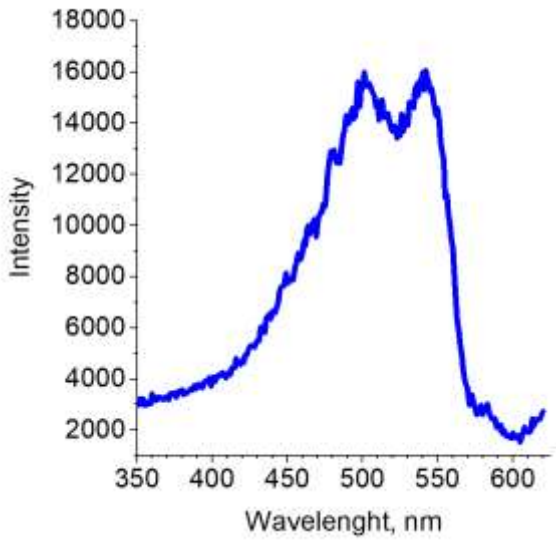

Figure S2. Excitation spectrum of PDA film, crystallized in the «red» form. λ_{em}=640 nm.

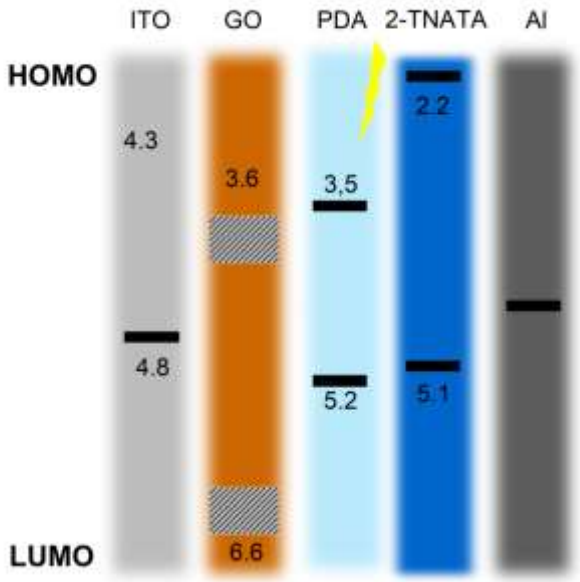

Figure S3. a) Schematically shown energy level diagram for the ITO/GO/PDA/2-TNATA/Al cell.

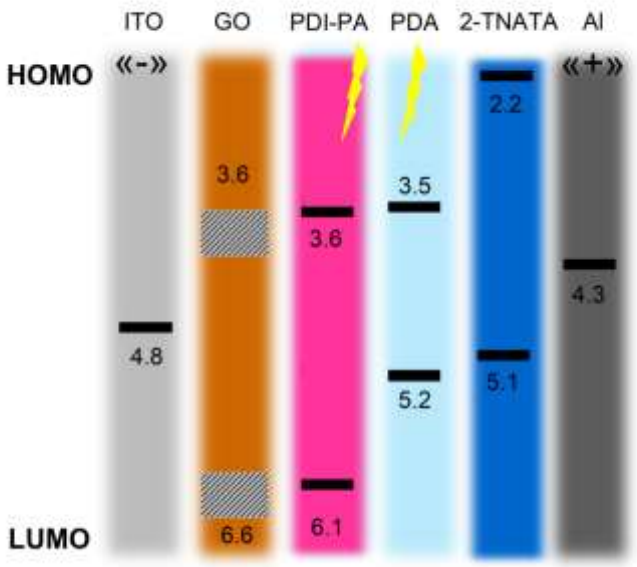

Figure S4. Schematically shown energy level diagram for the ITO/GO/Ni^{2+}/PDI-PA/Ni^{2+}/PDA/2-TNATA/Al cell.

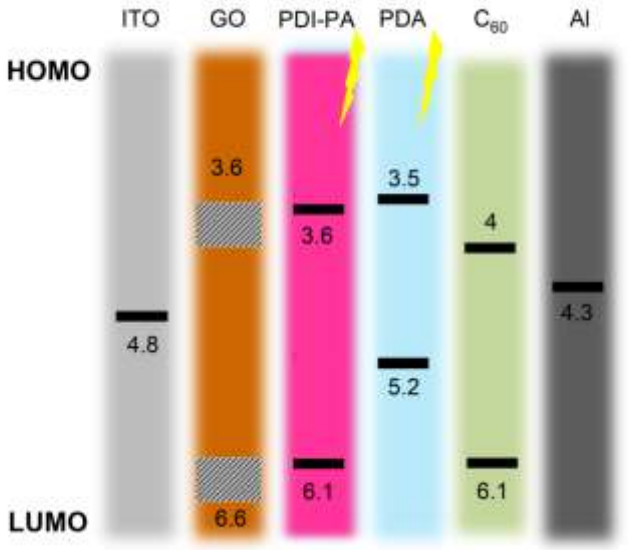

Figure S5. Schematically shown energy level diagram for the ITO/GO/Ni^{2+}/PDI-PA/Ni^{2+}/PDA/C_{60}/Al cell.

The HOMO and LUMO energies of GO, PDA, PDI-PA and work function of ITO, aluminum were taken from [1–5]. The values for 2-TNATA, C_{60} and BCP provided by the manufacturer.

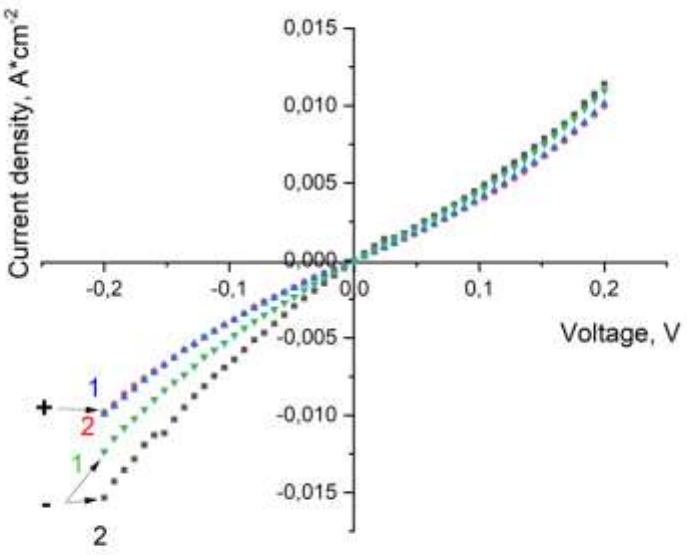

Figure S6. Current-voltage dependences of the ITO/GO/Ni^{2+}/PDI-PA/PDA/2-TNATA/Al cell measured for (*1*) photocurrent and (*2*) dark current under positive and negative bias on ITO.

Ellipsometry allows to determine experimentally the real (ε_1) and imaginary parts (ε_2) of the (complex) dielectric permittivity, from which the dielectric permittivity of GO/Ni^{2+}/PDI-PA/Ni^{2+}/PDA/2-TNATA film was calculated:

$$\varepsilon=\varepsilon_1+i\ \varepsilon_2.$$

Table S1. Values of ε_1, ε_2 and dielectric permittivity, obtained by ellipsometry, and RMS error of optical modeling.

ε_1	2.768
ε_2	0.664
ε	2.847
RMSE	6.18×10^{-8}

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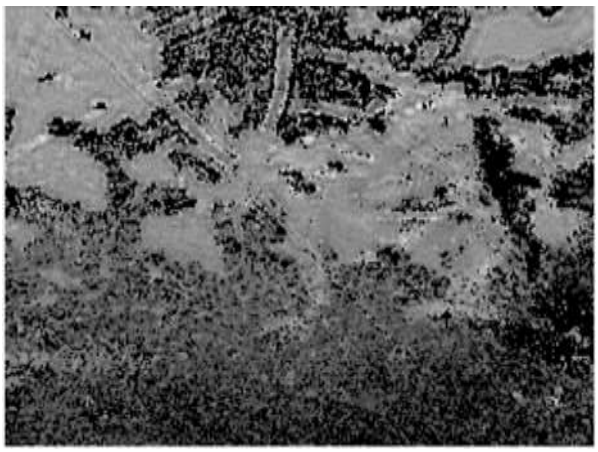

Figure S7. The area of the GO/Ni^{2+}/PDI-PA/Ni^{2+}/PDA/2-TNATA film from which the ellipsometric data were scanned.

References

(1) Zheng, F.; Xu, W. L.; Jin, H. D.; Hao, X. T.; Ghiggino, K. P. Charge Transfer from Poly(3-Hexylthiophene) to Graphene Oxide and Reduced Graphene Oxide. *RSC Adv.* **2015**, *5* (109), 89515–89520.

(2) Nishide, J. I.; Oyamada, T.; Akiyama, S.; Sasabe, H.; Adachi, C. High Field-Effect Mobility in an Organic Thin-Film Transistor with a Solid-State Polymerized Polydiacetylene Film as an Active Layer. *Adv. Mater.* **2006**, *18* (23), 3120–3124.

(3) Carmen Ruiz Delgado, M.; Kim, E. G.; Da Silva Filho, D. A.; Bredas, J. L. Tuning the Charge-Transport Parameters of Perylene Diimide Single Crystals via End and/or Core Functionalization: A Density Functional Theory Investigation. *J. Am. Chem. Soc.* **2010**, *132* (10), 3375–3387.

(4) Balasubramanian, N.; Subrahmanyam, A. Studies on Evaporated Indium Tin Oxide (ITO)/Silicon Junctions and an Estimation of ITO Work Function. *J. Electrochem. Soc.* **1991**, *138* (1), 322–324.

(5) Michaelson, H. B.; Michaelson, H. B. The Work Function of the Elements and Its Periodicity The Work Function of the Elements and Its Periodicity. **2012**, *4729* (1977), 1–6.