Electronic supplementary materials *Mendeleev Commun.*, 2025, **35**, 684–687

Lateral photoresistor as a versatile device platform for stability assessment of organic semiconductors

Petr M. Kuznetsov, Sergey L. Nikitenko, Mikhail V. Zhidkov, Dmitry P. Kirukhin, Evgeniy V. Golosov and Pavel A. Troshin

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1. Sample preparation

ITO slides (25x25 mm^2) were cleaned by ultrasonication in isopropanol, then dried with a stream of air and patterned using Sisma 200F confocal laser scribing system equipped with YAG (1064) 10W laser. The optimal scribing regime was at 17% of the maximum power with the pulse frequency of 80 kHz and scribing speed 500 mm/s. This results in the well-defined channel with the length of 70 μm. Afterwards, the samples were washed with isopropyl alcohol using cotton tips, cleaned by sonication in the same solvent and subjected to the air plasma treatment (40 kHz, 50W) for 5 min. All polymer solutions (8-10 mg/ml) were prepared inside the nitrogen-filled glove box using anhydrous chlorobenzene or1,2-dichlorobenzene as solvents (Sigma-Aldrich). The spin-coating rate was adjusted to obtain approximately the same film absorbance of 0.5-0.6 at the maximum of the major absorption band at long wavelengths. The contact plates were mechanically cleaned from the polymer film using a knife or a tweezer.

2. UV light aging

The aging setup was based on 172 W bacteriocidic UV lamps (J-19180 Ozone), which were fixed inside a stainless-steel box placed in inert nitrogen atmosphere inside MBraun glove box. The fan cooling of the setup resulted in equilibrium temperature of 65 ^oC. UV light power at the sample holder was ca. 30 mW/cm^2. The sample holder incorporated multiple cells; each could accommodate a single 25x25 mm sample. These cells were numbered and the incident light flux as calibrated for each cell. Only the cells with the same light flux within 5% error were used in the experiments. The polymer films deposited on patterned conductive substrates were illuminated from the top and their aging was monitored by periodic measurements of the electrical characteristics in a glove box without any exposure to ambient atmosphere.

3. Gamma rays exposure

The samples were sealed in 4-5 layers of Al-laminated plastic foil, which is typically used to form cases of pouch-type lithium-ion batteries. All these preparations were performed inside MBraun glove box with O_2 and H_2O content below 0.1 ppm. Afterwards, the package with the samples or sealed glass tubes were taken outside glove box and exposed to the ^{60}Co source of gamma rays with the dose rate of 2 Gy/s using the Gammatok-100 setup. The temperature inside the irradiation chamber was 45±2 ^oC. The dose rate calibration in the setup is carried out using the ferrosulfate method and the measurement error does not exceed 10%. After the samples received the first dose of gamma rays (e.g. 1 MGy), they were transferred back inside the glove box, the package was opened, the samples were characterized inside the same glove box and then packed again for the next gamma rays exposure cycle.

4. Electrical characterization

The I-V characteristics of the devices were measured using Keithley 2612A source-measurement unit within the range from -200 to 200 V. The home-made light source was based on the 10W white LED (6000 K) operated at 31V and stabilized at the current of 35A. The modulation of the light source was achieved using programmable Advantest ADCMT 6241A source-measurement unit.

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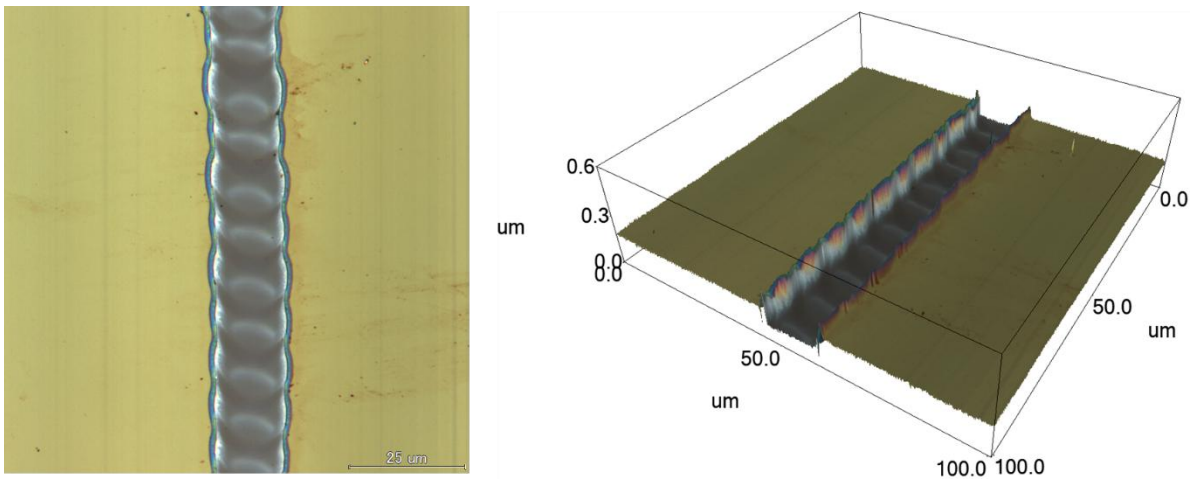

Figure S1. 2D and 3D images of the patterned ITO with the channel length of 18 μm produced using 5W UV laser (DuckMark Standart UV 3; 355 nm) operating in 86 kHz regime with the 800 mm/s operation speed.