Supplementary Information

Novel Conductive PEDOT:DBSA Hydrogel with Tuneable Properties for Bioelectronics

Romana Malečková, *[a] Šárka Tumová, [a] Petr Smísitel, [b] Jiří Smilek, [a] Helena Šimůnková, [b, c] Michaela Pešková, [d, e] Lubomír Kubáč, [f] Jaromír Hubálek, [b, c] Jan Víteček, [d] Martin Vala, [a] and Martin Weiter [a]

[a] *Faculty of Chemistry, Brno University of Technology, Purkyňova 464/118, 612 00 Brno, Czech Republic*

[b] *Central European Institute of Technology, Brno University of Technology, Purkyňova 656/123, 612 00 Brno, Czech Republic*

[c] *Department of Microelectronics, Faculty of Electrical Engineering and Communication, Brno University of Technology, Technická 3058/10, 616 00 Brno, Czech Republic*

[d] *Department of Biophysics of Immune System, Institute of Biophysics of the Czech Academy of Sciences, Královopolská 135, 612 65 Brno, Czech Republic*

[e] *Department of Biochemistry, Faculty of Science, Masaryk University, Kamenice 5, 625 00 Brno, Czech Republic*

[f] *Centre for Organic Chemistry, Rybitví 296, 533 54 Rybitví, Czech Republic*

* Corresponding author: Romana.Maleckova@vut.cz

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1 Strain sweep test of PEDOT:DBSA doped with 3 and 5 v/v % of DBSA

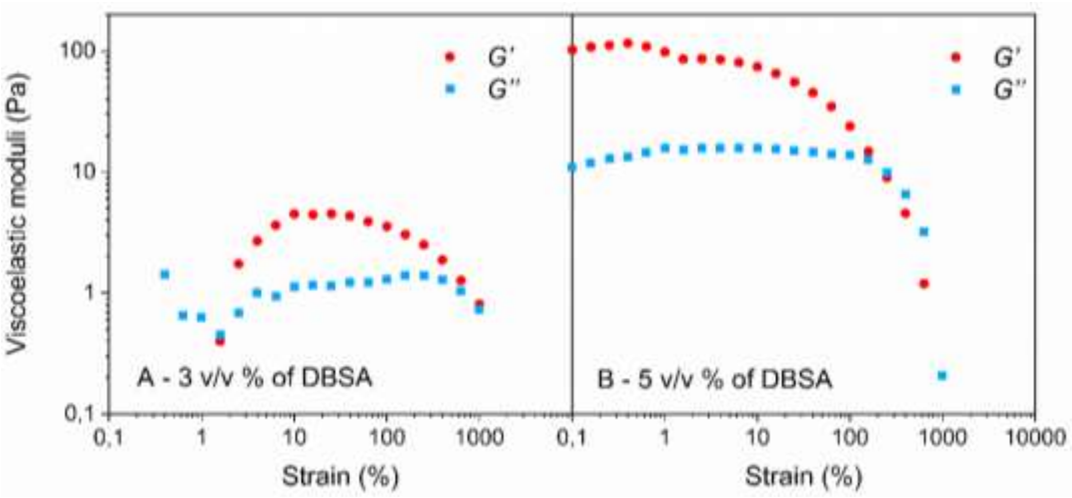

Figure S1: Strain sweep test of PEDOT:DBSA doped with A - 3 v/v % and B - 5 v/v % of DBSA. *G*' and *G*'' show the values of storage and loss modulus, respectively. A - at the beginning of the experiment, loss modulus (*G*'') predominates, which indicates a liquid nature of the sample, and that the hydrogel network did not evolve. B – storage modulus (*G*') predominates from the beginning of the experiment, indicating that the hydrogel network was formed.

2 Example of stress-strain curve for Young's Modulus determination

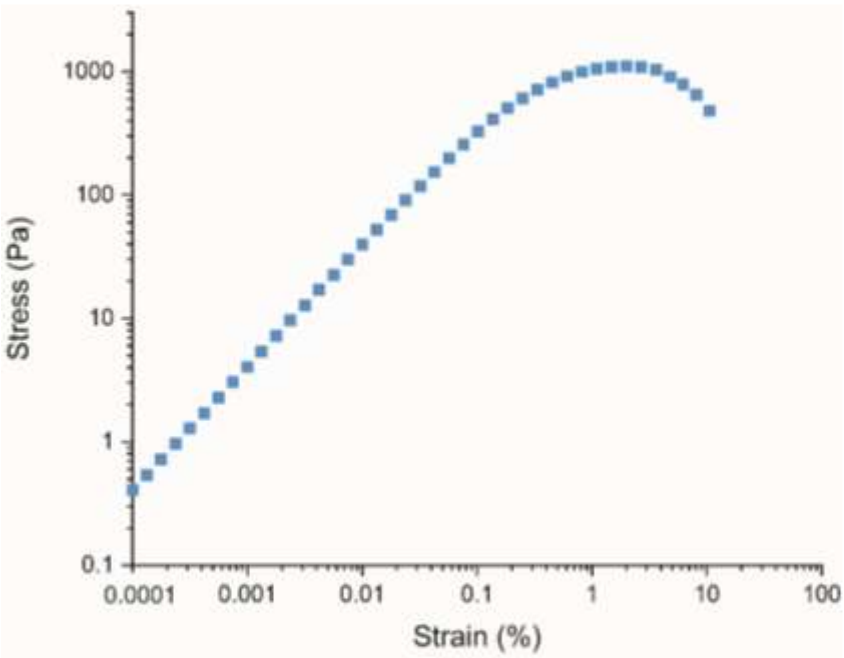

Figure S2: An example of the stress-strain curve for PEDOT:DBSA dopped with 5 v/v % of DBSA

3 Measuring cell for electrical characterization

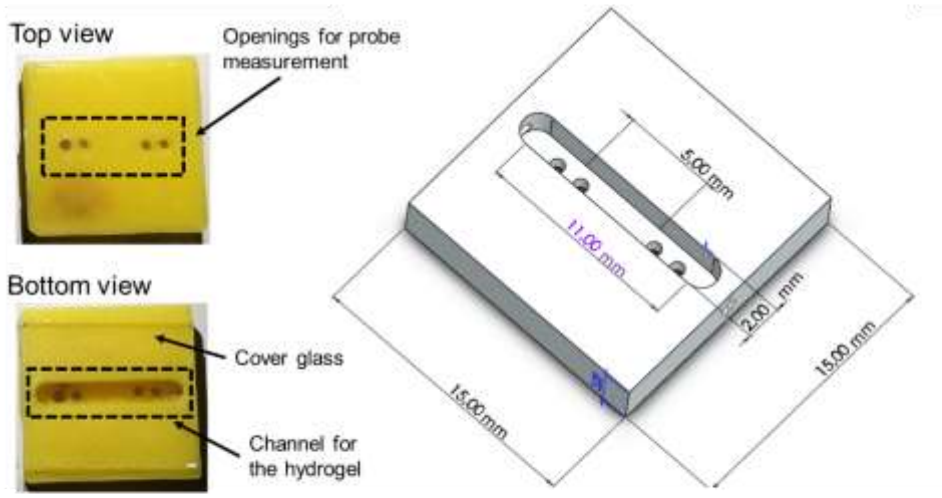

Figure S3: A closed cell for impedance measurement. In case of the PEDOT:DBSA hydrogel, the channel was carefully filled with prepared hydrogel and closed with a glass slide, using silicone elastomer (SYLGARD 184) and wax. In the case of the PEDOT:PSS hydrogel, the platform was first closed with the glass slide and subsequently filled with the mixture of PEDOT:PSS doped with DBSA (in liquid form) through the openings on the top of the platform. Gelation took place inside the channel within several minutes, depending on DBSA concentration. Both the top and side holes served to release air bubbles. After filling the channel, all holes were sealed using wax, to prevent any water evaporation from the hydrogel, before the end of the measurement. The cell might be used for three- or four-point electrode measurements.

4 Equivalent circuit of PEDOT:DBSA and PEDOT:PSS

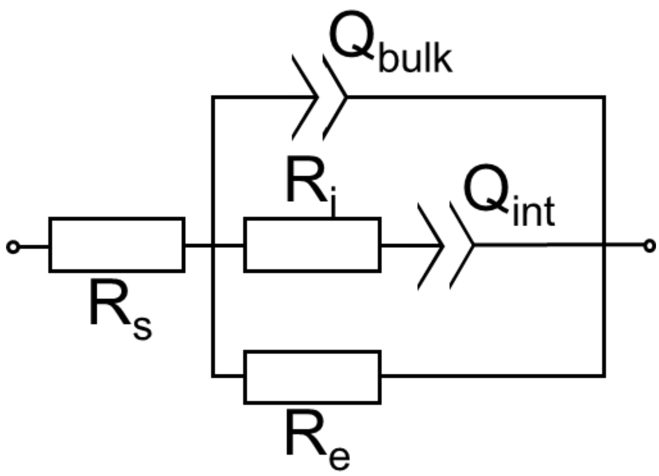

Figure S4: Equivalent circuit of the PEDOT:DBSA and PEDOT:PSS hydrogels considering a parallel connection of ionic and electronic resistance. R_i stands for ionic resistance, R_e for electronic resistance. The total resistance was determined as $R_1 = R_iR_e / (R_e + R_i)$.

5 Effect of the secondary dopant concentration on the conductivity of the hydrogels

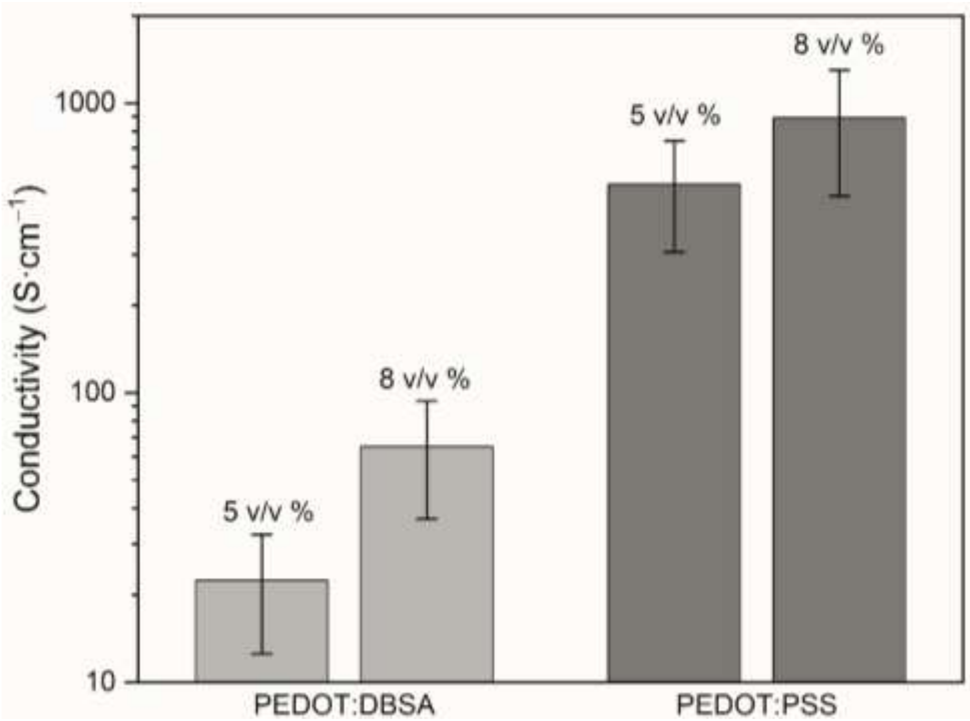

Figure S5: Effect of the secondary dopant concentration on the conductivity of PEDOT:DBSA and PEDOT:PSS hydrogel doped with 5 and 8 v/v % of the dopant. The value represents the mean of 4 samples (6 measurements per sample) ± standard deviation. The variability of the values can be attributed to the high sensitivity of the measurement to the variability of the electrode coverage (gold-plated tungsten needles). However, the trend is clearly visible for both materials; the higher concentration of the secondary dopant induces a higher crosslinking density of the hydrogel network, resulting in enhanced conductivity.

6 Resistivity calculation

The total resistivity of the hydrogels was calculated according to Equation (1)

$$\rho = R_1 \cdot \frac{S}{d} \quad (1)$$

Where ρ (Ω·m) is the total resistivity, R_1 is the measured total resistance (Ω), S is the surface of the working electrode (m^2), and d is the distance between the working and the auxiliary electrode (m).

7 The plot of impedance as a function of frequency

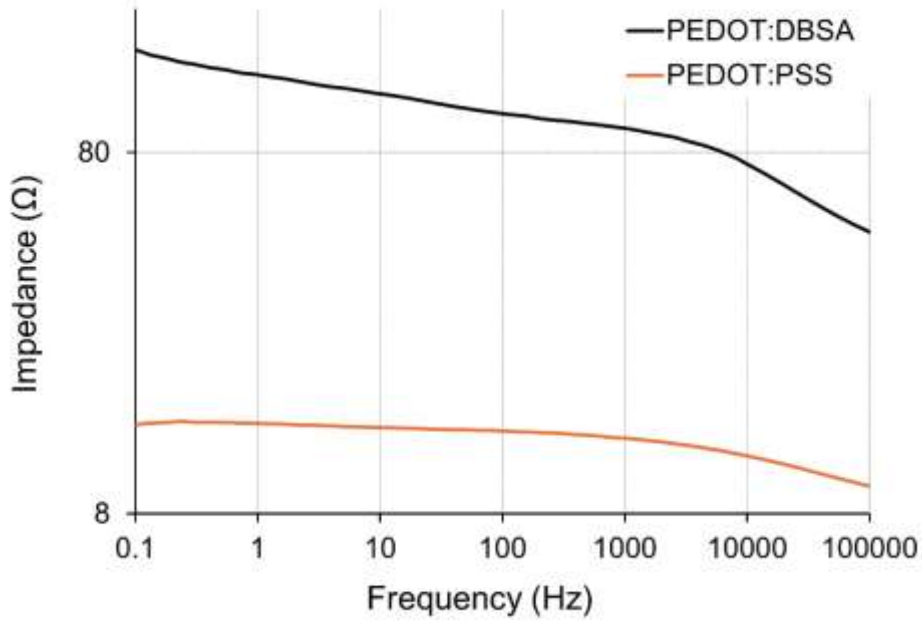

Figure S6: The plot of impedance as a function frequency for PEDOT:DSBA and PEDOT:PSS hydrogels, both doped with 5 v/v% of DBSA. The results show that the impedance decreases with the frequency in both cases.

8 Light microscopy

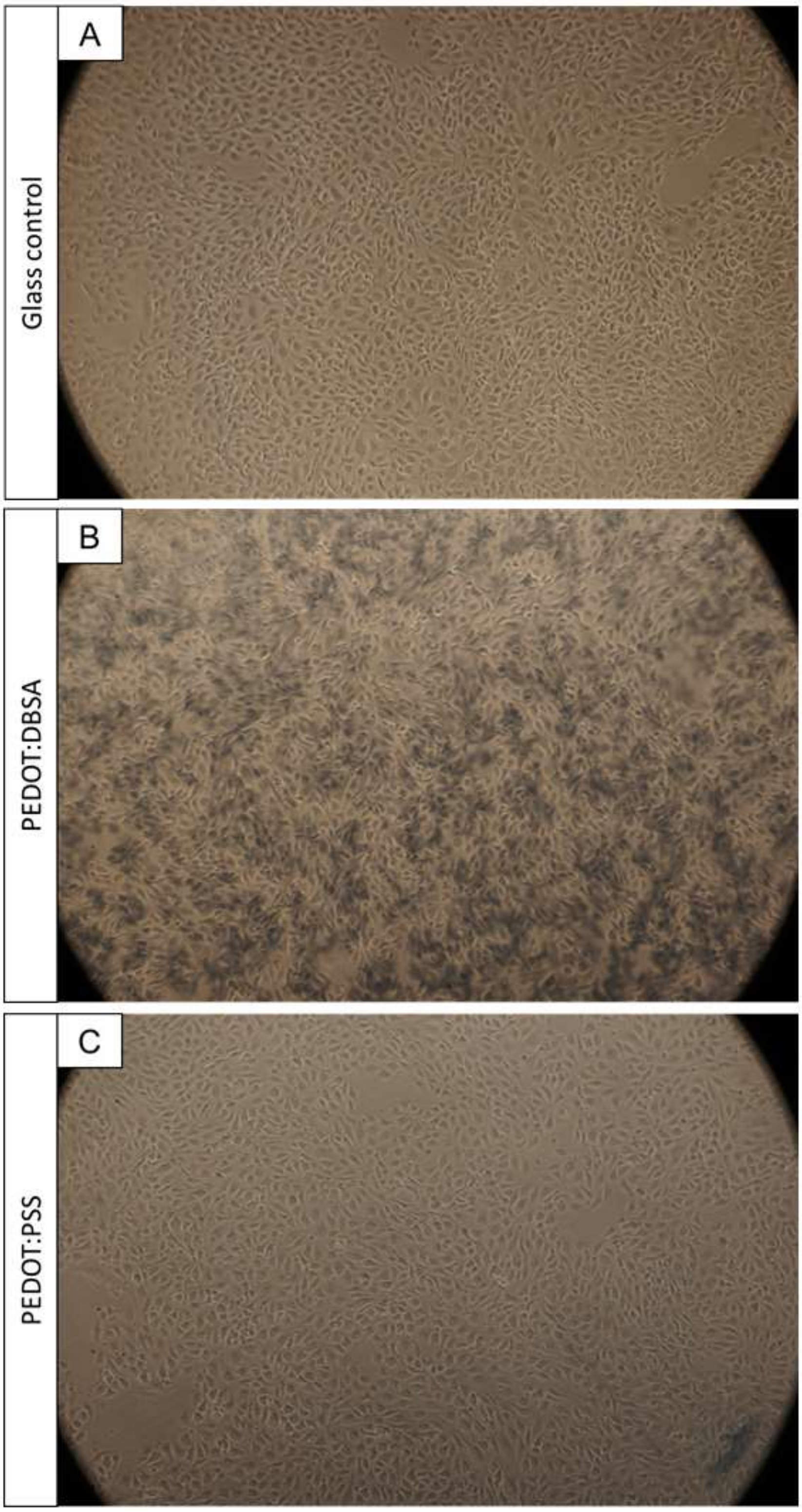

Figure S7: Light microscope images of MS1 endothelial cells cultivated on A culture glass; B the PEDOT:DBSA rehydrated hydrogel and C the PEDOT:PSS rehydrated hydrogel. Cells cultured on both hydrogels show the same morphology, as cells cultured on the glass control.