Scientific Report - Stage 2
(Period: 1 January - 31 December 2023)

The objectives of Phase 2 and the research results of the project PN-III-P1-1.1-TE-2021-0417 are as follows:

- Development of new cathodic nano-composite TiO_2rNSs- WO_3NSs thin films / FTO electrochromic / pseudocapacitive electrodes (part 2 - morphological characterisation by SEM, electrochemical and electrochromic).

New nano-composite cathode electrodes with the best electrochromic and pseudocapacitive properties were created using thin films made of TiO_2 and WO_3 nanostructures placed on FTO substrates, as shown in the table below:

Cathode electrodes/ Parameters	Band gap energy, (eV)	Charge transfer resistance, (Ω)	Density of load carriers, N_d	Optical modulations $\Delta T = T_d - T_c$, (%)	Response time, (s)	
					bleaching (t_d)	coloring (t_c)
WO_3NP/TiO_2rNS$_{dip_coat}$	2,82	145	$1,00*10^{18}$	41,24	5	4
WO_3NP/TiO_2rNS$_{mag_sputt}$	1,85	61,4	$1,72*10^{20}$	49,39	3	2,4
WO_3NF/TiO_2rNS$_{dip_coat}$	2,96	1480	$7,23*10^{17}$	75,41	4	3,5
WO_3NF/TiO_2rNS$_{mag_sputt}$	3,01	2740	$5,71*10^{17}$	48,85	4	5,5

- Developing new nano-hybrid anode electrodes using PPyNSs- and PEDOT:PSS-deposited thin films on an FTO substrate as a basis for TiO_2rNSs.

With the characteristics listed below, the following novel doped nano-hybrid anodic electrodes were created and are listed in the following table:

Anode electrodes/ Parameters	Band gap energy, (eV)	Density of load carriers, N_d	Optical modulations $\Delta T = T_d - T_c$, (%)
PPyI/C/TiO_2rNS/FTO	3,13	-1,86E+18	20,3
PPyI/QDs/TiO_2rNS/FTO	3,17	-1,58E+18	22,5
PPyII/C/TiO_2rNS/FTO	3,17	-1,21E+18	16
PPyII/QDs/TiO_2rNS/FTO	3,23	-1,04E+18	21
PEDOT:PSS/C/TiO_2rNS/FTO	3,12	-1,58E+18	46

For usage in creating anode electrodes for smart window applications, all hybrid polymer films doped with either C or QDs that were produced by electrochemical, electrospinning, or spin-coating techniques, respectively, show acceptable pseudocapacitive and electrochemical characteristics.

- Obtaining biopolymer electrolytes with high ionic conductivity by doping DNA with Li^+ or Zn^{2+} ions.

The highest values of ionic conductivity were obtained for DNA-based biopolymer electrolytes doped with 1 wt% PL (Film B) and doped with 2 wt% SZ (Film G), respectively.

Results dissemination:

- 1 ISI Q1 article published in Materials, 16 April 2023, 16, 3147. https://doi.org/10.3390/ma16083147;

- 1 ISI Q1 article accepted in Materials, 29 November 2023, 16, x. https://doi.org/10.3390/xxxxx;

- Participation in 2 International Conferences with 3 scientific papers;

- 1 published patent application: nr. RO137718 (A0), 2023-10-30.