biolar

September 2025

Project No: 1.1.1.3/1/24/A/070 Interim Results.

HYBRID ORGANIC-INORGANIC NANOCOMPOSITES AND NANOSTRUCTURED MATERIALS FOR FLEXIBLE X-RAY DETECTORS (2025-2028)

Co-funded by the European Union

2027 National Development Plan

During the first three months of the project implementation, the following work was carried out:

1. Literature on the principles of X-ray detector operation was reviewed, along with publications and patents on existing devices. Information was gathered on materials and substances used in similar systems.
2. Meetings and ongoing communication between project participants were established. The collected information was discussed, and brainstorming sessions were held to explore potential research directions. Several promising ways were identified.
3. Several trial syntheses were performed for candidate monomer compounds potentially suitable for p-type polymer semiconductors. The corresponding scientific literature was studied, and initial steps were taken toward developing synthesis methodologies, as well as preliminary analytical and purification strategies.
4. A list of missing reagents for synthesis was compiled, and the necessary chemicals and labware were ordered.
5. **Electron microscopy (SEM and TEM)** studies were performed. SEM characterization of SnS_2 nanoplates in liquid and TEM analysis of WSe_2 nanowires were carried out to verify synthesis quality and provide a baseline for further material development.
6. Adhesion tests were conducted between PET layers and acrylate polymer films, which may serve as flexible substrates for the detectors.

December 2025

Reporting period: 01.09.2025 – 30.11.2025

1. A series of intermediates was synthesized, which will subsequently be used for the synthesis of ligands and the coordination polymers themselves.
2. Several Ni-DABDT coordination polymer samples with different structures were synthesized.
3. The structure of the synthesized compounds was investigated using NMR and XRD methods.

March 2026

Reporting period: 01.12.2025 – 28.02.2026

1. Continued literature research related to the synthesis of organic semiconductors, particularly in the field of coordination polymers based on metals and organic ligands.
2. A variant of the Ni-DABDT (#7) compound containing dodecyl groups was synthesized.
3. Test syntheses of the new Mo-DABDT (#1–#3) compound were carried out. The structure of the synthesized compounds was investigated using nuclear magnetic resonance (NMR) and X-ray absorption spectroscopy (XANES/EXAFS) methods.

June 2026

Reporting period: 01.03.2026 – 31.05.2026

1. Continued literature research related to the synthesis of organic semiconductors, particularly in the field of coordination polymers based on metals and organic ligands.
2. Test syntheses of the new Mo-DABDT (#4–#8) compounds were carried out.
3. The properties and structure of the synthesized Mo-DABDT compounds were investigated using optical spectrometry, nuclear magnetic resonance (NMR), X-ray diffraction, and X-ray absorption spectroscopy (XANES/EXAFS) methods.

September 2026

Reporting period: 01.06.2026 – 31.08.2026

1. The literature review related to the synthesis of organic semiconductors was continued, with particular emphasis on coordination polymers based on metals and organic ligands.
2. Within the framework of the work, the molybdenum complex compound Mo-DABDT was synthesized using both a standard and an improved synthesis procedure involving the slow addition of reagents at low temperature. UV-Vis absorption spectra were recorded for both obtained samples, and their solubility in various organic solvents was evaluated using the absorbance at 410 nm.
3. The X-ray-induced current in Mo-DABDT was measured using a laboratory X-ray source, confirming the material's potential for direct-conversion X-ray detection. Mo K-edge X-ray absorption spectroscopy of Mo-DABDT provided detailed information on the local coordination environment and oxidation states of the molybdenum atoms in the coordination polymers. Structural relaxation using universal machine-learning interatomic potentials combined with the Reverse Monte Carlo method enabled reconstruction of the structure in agreement with the experimental EXAFS data.
4. The project results on coordination polymers for use in X-ray detectors (K. Pudzs, A. Stepanovs, I. Pudza, A. Gerbreders, A. Kuzmin, "Ni-DABDT and Mo-DABDT coordination polymers for flexible X-ray detectors") were presented at the FM&NT-2026 conference (15–18 June 2026, Riga, Latvia) as a poster presentation.

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