

Annotations of Doctoral Thesis Topics for Degree Programme
“Nanotechnology and Advanced Materials”

Topic: Preparation, characterization and polymerization of bithiophene monomers with carbazole pendant group

Tutor: prof. Ing. Jarmila Vilčáková, Ph.D.

Consultant: -

E-mail: vilcakova@utb.cz

Annotation:

The dissertation will focus on the synthesis of bithiophene monomers with a carbazole functional group and thiophene monomers substituted with a group suitable for subsequent quaternization, as well as their subsequent polymerization. The goal is to develop and characterize new materials for electronics in the field of memristors. The design of suitable monomers will be supported by quantum chemical calculations. The chemical identity of the synthesized monomers will be verified using chromatographic methods, NMR, and FTIR spectroscopy. The outcome will be synthesized monomers, which will subsequently be polymerized primarily through oxidative polymerization and coupling reactions. Polymers with various side chain lengths and potentially functional groups on the side chains will be studied using thermodynamic methods (TGA, DSC), Raman scattering, optical methods (UV-VIS, steady-state fluorescence). The polymers will differ in molecular weight, rigidity, and side chain length, which will influence charge transport and their memristive behavior.

Requirements:

Knowledge of general and macromolecular chemistry and physics at the university level. Good knowledge of the English language or a potential to the improvement. Basic manual and laboratory work skills. Ability to work independently.

Literature:

1. Grant Benjamin; Bandera Yuriy; Foulger, Stephen H.; Vilčáková, Jarmila; Sába, Petr; Pflieger Jiří: Boolean and elementary algebra with a roll-to-roll printed electrochemical memristor, *Advanced Materials Technologies*, 2022, 7, Article Number 2101108, DOI: [10.1002/admt.202101108](https://doi.org/10.1002/admt.202101108)
2. Foulger, Stephen H.*; Bandera, Yuriy; Benjamin Grant; Vilčáková, Jarmila; Sába, Petr: Exploiting multiple percolation in two-terminal memristor to achieve a multitude of resistive. *Journal of Materials Chemistry C*, 2021, vol. 9, pp.8975-8986, DOI 10.1039/d1tc00987g

3. Terje A. Skotheim, John Reynolds: Conjugated Polymers Theory, Synthesis, Properties, and Characterization, Book, 3rd Edition, First Published 2006, Imprint CRC Press. DOI: <https://doi.org/10.1201/9781420043594>
4. McFarlane, Tucker M.; Bandera, Yuriy; Grant Benjamin; Zdyrko, Bogdan; Foulger, Stephen H.; Vilčáková, Jarmila; Saha, Petr; Pflieger, Jiří. Carbazole Derivatized n-Alkyl Methacrylate Polymeric Memristors as Flexible Synaptic Substitutes. *Advanced electronic materials*, 2020,