



Topic of dissertation thesis

Academic year **2026/2027**

Title	Design, fabrication, and characterization of fiber-optic sensors based on micro-deposition of optical polymers.		
Institute	Faculty of Electrical Engineering and Information Technology University of Žilina		
Place	Žilina, Slovakia		
PhD. programme	electrotechnologies and materials		
Supervisor	Daniel Kacik, doc. Ing. PhD. Department of physics		
Co-supervisor	Kliknite alebo ťuknite sem a zadajte text. Kliknite alebo ťuknite sem a zadajte text.		
Study form	Internal		
Study duration	3 years (internal form)		
Study language	english		
Start date	1.9.Kliknite alebo ťuknite sem a zadajte text.		
Research domain	Domain 3		
Contact person	Phone:	E-mail:	Web-page
	+421415132323	kacik@uniza.sk	Kliknite alebo ťuknite sem a zadajte text.

Dissertation topic abstract

This dissertation focuses on acquiring new theoretical knowledge in the field of fiber photonics and its subsequent implementation in the development of innovative sensors. The main objective of the research is the design, fabrication, and comprehensive characterization of photonic structures integrated directly onto optical fibers with special geometries. The core of the work lies in the utilization of D-type optical fibers (D-fibers), whose properties are modified through the micro-deposition of selected optical polymers. These hybrid structures enable efficient light-matter interaction with the surrounding environment, which is crucial for high-sensitivity sensing of physical quantities. The developed sensors are primarily designed for the precise measurement of the refractive index, analysis of related environmental parameters, and detection of mechanical strain using modern optical methods. The experimental part of the thesis focuses on studying the optical properties of the prepared structures in the visible (VIS) and near-infrared (NIR) spectral regions. The output of the dissertation will be a design methodology and prototypes of miniature fiber sensors which, due to their dimensions and high sensitivity, will find applications in demanding industrial and technical practice.

Extended information, research responsibilities and tasks of PhD. candidate

To conduct a comprehensive literature review and theoretical analysis of the evanescent field interaction in optical fibers with modified geometries (D-fibers). To design optimal parameters for the polymer layers (thickness, refractive index) using numerical simulations to achieve maximum sensor sensitivity. To develop and optimize a micro-deposition methodology for selected optical polymers onto the polished or etched surface of the D-type fiber. To ensure the repeatability and stability of the deposition process to achieve predefined geometric and optical properties. To perform spectral measurements of the fabricated photonic structures in the visible (VIS) and near-infrared (NIR) regions. To analyze the impact of environmental changes (refractive index of liquids and gases) on the sensor's transmission characteristics. To determine key sensor parameters, such as sensitivity, limit of detection (LOD), and response linearity during refractive

index and mechanical strain measurements. To verify the effects of thermal cross-sensitivity and the long-term stability of the sensor. To design and implement a functional prototype of a miniature fiber-optic sensor suitable for integration into technical devices or monitoring systems.

Candidate profile

Required qualifications:

(The supervisor defines the required qualification, skills and knowledge for the proposed dissertation topic.)

Education and Core Knowledge Academic Background: Master's degree (MSc. / Ing.) in Physical Engineering, Optics, Photonics, Microelectronics, Materials Science, or a related technical field. **Theoretical Foundation:** Strong understanding of wave optics and a solid overview of optical sensor principles (refractive index sensing, interferometry, and absorption spectroscopy). **Laboratory and Technical Skills** **Fiber Optics Handling:** Hands-on experience with optical fibers, including stripping, cleaving, cleaning, and fusion splicing. **Instrumentation:** Proficiency in operating optical measurement devices, such as Optical Spectrum Analyzers (OSA), broadband light sources, and photodetectors. **Material Processing:** Basic experience in working with polymers (e.g., UV-curable adhesives, photoresists) and thin-film preparation techniques. **Precision Work:** High level of manual dexterity for mechanical micromanipulation and the ability to work effectively under a microscope. **Software and Analytical Skills** **Numerical Simulations (Advantage):** Familiarity with EM wave simulation software such as COMSOL Multiphysics, Lumerical (Ansys), RSoft, or custom MATLAB-based modeling tools. **Data Analysis:** Ability to process measured spectra and perform statistical evaluations of sensitivity, detection limits, and measurement errors using tools like OriginLab, Python, or MATLAB. **Scientific Reasoning:** Strong analytical skills with the ability to independently interpret experimental results and draw technical conclusions.

Preparation of the dissertation topic proposal up to 2 pages!