

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

**Topic:** Smart systems based on polymeric nanocomposites

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**Annotation:**

The PhD thesis will be focused on the preparation of the polymer nanocomposites those providing certain response upon external stimuli. In this case, the chosen polymer is based on poly(vinylidene fluoride) and dielectric nanoparticles. Preparation of the nanocomposites will be optimized in order to maximize the response on the various types of vibrations. By enhancement of the detection sensitivity it is possible to the early detect the damage of the individual parts and thus prevent the wide and expensive repair. The smart nanocomposites will be investigated using various techniques for filler dispersion (scanning electron microscopy, microtomography) and evaluation using thermal analysis i.e. differential scanning calorimetry, dynamic mechanical analysis to measure the mechanical properties. Furthermore, it will be investigated capability of such system on the pressure and vibration stimuli in form of electrical output using high-precision electrometers and finally the investigation of the prepared system against long-term exposure will be performed.

**Requirements:**

Ability to work independently and creatively, knowledge of English language, university degree in the field of polymer materials and their processing or related fields.

**Literature:**

1. FLORCZAK, Sammy; LORSON, Thomas; ZHENG, Tian; MRLIK, Miroslav; HUTMACHER, Dietmar W; HIGGINS, Michael J; LUXENHOFER, Robert; DALTON, Paul D. Melt Electrowriting of Electroactive Poly(vinylidene Difluoride) Fibers. *Polymer International*. 2019, vol. 68, no. 4 s. 735-745. ISSN:0959-8103.
2. SHEHATA, Nader; KANDAS Ishac; HASSOUNAH Ibrahim; SOBOLCIAK Patrik; KRUPA; MRLIK, Miroslav; POPELKA, Anton; STEADMAN, Jesse; LEWIS, Randolph. Piezoresponse, Mechanical, and Electrical Characteristics of Synthetic Spider Silk Nanofibers. *Nanomaterials*. 2018, vol. 8, no. 8 art. no. 585. ISSN:2079-4991.
3. TICHÝ, Jan et al. Fundamentals of piezoelectric sensorics: mechanical, dielectric, and thermodynamical properties of piezoelectric materials. Heidelberg: Springer, 2010. ISBN 978-3-540-43966-0.
4. LI, M., LIU, JZ., ZHENG, DZ., ZHENG, MS., ZHAO, Y., HU, MJ., YUE, GH., SHAN, GC., Enhanced dielectric permittivity and suppressed electrical conductivity in polyvinylidene fluoride nanocomposites filled with 4,4-oxydiphenyl-gunctionalized graphene, *Nanotechnology*, 2019, vol. 30, art. no. 265705.
5. JIANG, LQ., XIE, HA., HOU, Y., WANG, S., XIA, YS., LI, Y., HU, GH., YANG, QL., XIONG, CX., GAO, ZDF., Enhanced piezoelectricity of a PVDF-based nanocomposite utilizing high-yield dispersions of exfoliated few-layer MoS<sub>2</sub>, *Ceramics International*, 2019, vol. 45, pp. 1134-11352.