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Biomaterials and Tissue Engineering Research Center

Shanghai Institute of Ceramics, Chinese Academy of Sciences

中国科学院上海硅酸盐研究所生物材料与组织工程研究中心

Novel magnetoelectric nanomaterials for wireless electrical stimulation in biomedical applications

Speaker：Dr. Roman Chernozem

(PIFI Visiting Scholar of CAS，Tomsk Polytechnic University)

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报告地点：4号楼14楼第一会议室

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欢迎广大科研人员和研究生参加!

Abstract:

To save patients and improve the quality of life and consequently economic growth, the research in this field has a very high priority. In this regard, minimally invasive surgical tools as nanoscale structures have attracted great research interest in solving complicated in vivo problems associated with targeted drug delivery and tumor treatment. For a non-invasive safe in vivo application, wirelessly powered nanomaterials propelled by external stimuli are very promising compared to chemical or biological propelling. The issues associated with cargo release triggered passively by unstable physiological conditions (pH, temperature) and the use of the same propelled source for controllable locomotion and on-demand triggered therapeutics can be overcome by the in-situ application of piezoelectric, magnetic and magnetostrictive materials (magnetoelectric (ME) nanorobots). While a magnetic component provides precise delivery, the ME effect (polarization under the external AC magnetic field) will allow onsite triggered therapeutic release. Also, electrical stimuli of piezoelectric effect (PE, polarization under the mechanical loading as ultrasound) in ME nanomaterials can be used to electrically stimulate cell growth/differentiation and tissue repair or inhibit/kill cancer cells. Despite the advantages, the attention should be addressed to several challenges for real clinical applications: biocompatibility; size-effect and morphology; flexibility and bioactivity; effective and safety profile of magnetic, piezo- and magnetoelectric effects; and reproducibility. Thus, our aim is to elaborate novel bioactive ME nanorobots combining controllable targeting, triggered cargo release, biocompatibility, adaptable structures, precise controllability of PE and ME, low toxicity, minimal potential immunogenic responses, flexibility and biodegradability.

Personal information:

Dr. Roman Chernozem is an Associate Professor at the Research School of Chemistry & Applied Biomedical Sciences and a Senior Researcher at the Piezo- and Magnetoelectric Materials Center of National Research Tomsk Polytechnic University. He received a double Ph.D. degree in 2022, such as Ph.D. in Condensed Matter Physics (Tomsk Polytechnic University) and Ph.D. in Bioscience Engineering (Ghent University, Belgium). He is a broad-profile specialist working in the field of biomedical materials science. The key work experience is related to the development and research of micro- and nanostructured multiferroics, including polymers, metal and ceramics, with the possibility of external stimulation (mechanical, electrical and magnetic) for a programmable biological response. Currently, Assoc. Prof. Chernozem are performing joint research in the group of Prof. Chengtie Wu at the Shanghai Institute of Ceramics of Chinese Academy of Sciences (CAS) as a Visiting Scholar of PIFI CAS for 6 months.

Assoc. Prof. Chernozem has published over 35 peer-reviewed papers in high-impact journals, *e.g.*, Nano Energy, Adv. Fun. Mater, Small, etc.