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[Energy Distinguished Lecture Series]

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Biomimetic Coiled Fiber-based Integrative Electrochemical Energy Systems

N Center #86120, Sungkyunkwan University, Suwon

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Abstract

Nature offers remarkable examples of hierarchical structures that combine mechanical flexibility, structural stability, and multifunctionality. Inspired by these biological architectures, this seminar explores the design and engineering of twisted and coiled fiber systems for advanced electrochemical energy applications. In particular, carbon nanotube (CNT)-based fibers provide a versatile platform for integrating electrical conductivity, mechanical stretchability, energy storage, and actuation within compact, deformable structures.

The seminar first introduces structural engineering strategies for functional fibers, including twist insertion, electrochemical oxidation, and biomimetic architectures such as supercoils and double helices. These approaches enable enhanced structural stability, electrochemical performance, and mechanical adaptability, supporting applications in stretchable conductors, fiber-shaped supercapacitors, and artificial muscles. Building on these advances, the discussion extends to hydrovoltaic energy harvesting, which exploits interfacial interactions between water and functional nanomaterials to generate electrical energy.

Finally, the seminar presents a future research direction toward integrated, self-powered bioelectronic systems that combine energy harvesting, storage, physiological sensing, and electrical stimulation. By bridging fiber materials engineering, electrochemistry, and biomedical applications, this research aims to establish a foundation for sustainable, mechanically compliant, and potentially implantable healthcare technologies.

Brief Bio



Dr. Wonkyeong Son is an Assistant Professor in the Department of Biomedical Engineering at Konkuk University (GLOCAL Campus), South Korea. He received his B.S. degree in Bio-Nano Engineering (2016) and M.S. degree in Electronic Engineering (2018) from Hanyang University, and his Ph.D. degree in Energy Science from Sungkyunkwan University (2024). Prior to joining Konkuk University, he worked as a postdoctoral researcher in the Department of Biomedical Engineering at Hanyang University and the Department of Biomedical Sciences at Seoul National University College of Medicine. His research focuses on biomimetic fiber architectures, carbon nanotube-based functional materials, electrochemical energy systems, and self-powered bioelectronics for healthcare applications. Over the past four years, he has published 10 first-author research papers in leading international journals, including Advanced Materials, ACS Nano, npj flexible electronics, and Advanced Functional Materials. He is also the principal investigator of a five-year research project funded by the Sejong Science Fellowship.

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