



The City College
of New York

Thursday 3rd of September, 2:00 pm
CDI Building, 4N conference room

Rational Design of Mesoporous Carbons for Advanced Batteries

Wei Yu

Institute of Multidisciplinary Research for Advanced Materials (IMRAM), Tohoku University, Japan

Email: yu.wei.a3@tohoku.ac.jp

ABSTRACT

Graphene mesosponge (GMS), synthesized by chemical vapor deposition (CVD) using oxides as templates, is a mesoporous material composed mainly of single-layer graphene walls. With unique properties such as high surface area, good elasticity and conductivity, few edge sites, and abundant topological defects, GMS is not only a promising commercially available material for various applications but also an ideal model for fundamental research in energy storage devices. In recent years, we have explored the use of typical GMS synthesized with methane as the carbon source for CVD in supercapacitors, Li-S, and Li-O₂ batteries. For example, free-standing GMS-sheets with hierarchical porous structures exhibit a state-of-the-art high energy density of around 800 Wh kg⁻¹ in Li-O₂ batteries, establishing them as benchmark carbon cathodes in this field. Additionally, a series of functionalized GMS-based materials with heteroatom doping, highly dispersed metal nanoparticle loading, and high-purity ¹³C isotope labeling have been synthesized to elucidate the origin of quantum capacitance in supercapacitors and the reaction/degradation mechanisms in Li-O₂ batteries. In this presentation, I will summarize the design principles, synthesis, properties, and current applications of GMS materials. Furthermore, as a perspective, the potential use of GMS in other energy devices will be discussed.

Short Bio

Dr. Wei YU is an associate professor at *Tohoku University* (Japan). He received his Ph.D. in materials science and engineering in 2018 from *Tsinghua University* in China under the supervision of Prof. Feiyu Kang. He then conducted postdoctoral research with Prof. Ce-Wen Nan, also at *Tsinghua University*, and joined Prof. Hiroto Nishihara's group at *Tohoku University* in November 2020. He was promoted to tenure-track assistant professor (PI) in April 2025 and to associate professor in June 2026 at *Tohoku University*. His current research focuses on the rational design of carbon materials and the development of unique *in situ* characterization techniques for beyond Li-ion batteries. He has 32 peer-reviewed publications and three international/Chinese patents. He has secured eight grants as PI supported by JSPS KAKENHI, JSPS Bilateral Collaboration Project, and China Postdoctoral Science Foundation. He serves as a youth editorial board member for two international journals, *ACS Applied Energy Materials* and *Energy Materials Devices*.