

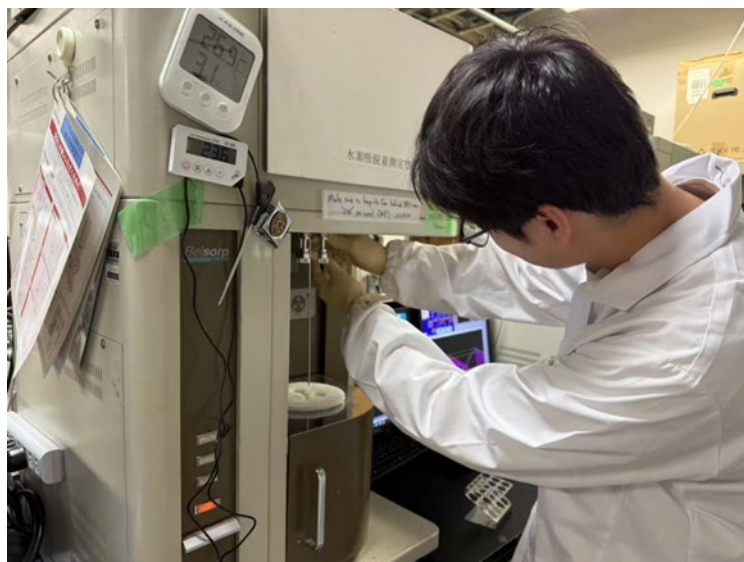
【2025 SyDE 産官学協働研修 実施報告】2025.7.7～2025.7.11

I participated in a short-term internship at 3DC Inc. in July 2025 as part of the “industry-government-academia collaborative training” program. The purpose of this internship was to advance the large-scale synthesis and structural understanding of flexible porous carbon materials, specifically carbon mesoporous sponge (CMS) and its heat-treated sample, graphene mesoporous sponge (GMS). These mesoporous carbons exhibit a unique sponge-like nanostructure composed of mainly single-layer graphene walls, and have attracted much attention in energy storage, sensors, and adsorption, due to the unique combination of high surface area, mechanical flexibility, and electrical conductivity.

During my internship, I first focused on the optimization of large-scale synthesis of CMS/GMS by chemical vapor deposition (CVD) using an advanced rotary kiln system in 3DC. The main challenge of scale-up synthesis in the lab is uniform carbon coating and inefficient gas flow. Here, we finally achieved gram-scale production of CMS with high reproducibility and quality through gas flow control process. Furthermore, I conducted structural characterizations of CMS, including estimating the average graphene sheet size by analyzing gas desorption using high-temperature temperature-programmed desorption (TPD). I also learned how to perform vapor adsorption under mechanical compression, which is a crucial method to evaluate the pore structure and mechanical stability of porous materials upon pressure and release. The results showed that the pore volume decreases significantly under pressure but recovers after releasing the pressure, which indicates excellent structural flexibility and durability of CMS.

In summary, this training allowed me to bridge the gap between academic research and industrial production. I am glad to have such precious experience using production-scale equipment and learned how to solve practical issues in materials processing. I also appreciated the discussions with 3DC staff, who shared very valuable insights on quality control and practical considerations. For me, this training was an enriching experience that enhanced my technical skills and reinforced the value of lab-industry collaborations from experiment to practice.

Xia Tian (工学研究科・化学工学・D2)



Studying vapor adsorption



Conducting material synthesis