



## **Department of Materials Science and Engineering Seminar Series 2025**

### **Additive Manufacturing of Stimuli-Responsive Polymer Composites for Environmentally Adaptive Applications**

**Liu Weilin**

**Date and time: 25<sup>th</sup> May, 10:00 AM**

**Venue: EA-02-15**

#### **Abstract**

Stimuli-responsive polymer composites and additive manufacturing have enabled the development of programmable materials that adapt to their environment. However, existing systems are often limited by slow response, weak mechanical properties, and poor integration between material functionality and structural design.

This work systematically investigates functional polymer composites to overcome these performance trade-offs. First, a high-capacity hygroscopic hydrogel (LiCl-HG) is engineered into micro-porous gyroid architectures via Digital Light Processing (DLP) to prevent salt leakage while optimizing moisture regulation kinetics. Second, its 4D printing capabilities are extended to autonomous hygromorphic actuation, where printing-induced micro-layering accelerates volumetric swelling kinetics while retaining self-healing properties. Finally, a thermal reconfiguration strategy is established for Fused Deposition Modeling (FDM) printed polylactic acid (PLA), leveraging strain-induced cold crystallization to dynamically rewrite its

permanent equilibrium geometry. This work provides a versatile framework for designing autonomous, self-fitting smart structures across adaptive engineering applications.

## **Biography**

Weilin Liu is currently a Ph.D. candidate in the Department of Materials Science and Engineering at the National University of Singapore, under the supervision of Prof. Jun Ding. His doctoral research focuses on the design, development, and advanced manufacturing of stimuli-responsive polymer systems for environmental moisture management and structural adaptability. He integrates advanced 3D and 4D printing techniques to manipulate functional properties across multiple length scales. His work spans the formulation of stable, high-capacity hygroscopic hydrogel networks for atmospheric moisture regulation, the engineering of autonomous self-healing actuators, and the development of thermally reconfigurable thermoplastic platforms for adaptive structural applications.

**Please join us!**

HOST: Asst Prof Zhong Peichen