**Master Thesis Topic:** *In situ* pyrolysis under SEM for architected carbon

**Job Description:**

Architected pyrolytic carbon has been emerging as a special class of material, where the interesting and unique properties of carbon marry architectural properties, exhibiting highly superior functionalities compared to bulk carbon. The fabrication of architected carbon involves 3D shaping of a polymeric precursor using an additive micro/nanomanufacturing process, followed by pyrolysis in an inert atmosphere. Pyrolysis converts the polymeric precursor into carbon, which also associates with a significant geometrical shrinkage, allowing a geometric dimension significantly smaller than the resolution of the involved manufacturing process. Even though architected carbon has been demonstrated for several applications, including energy, structural materials, and healthcare, the material transformation during pyrolysis is still not fully elucidated and needs extensive research. One of the important aspects of pyrolysis is the shrinkage phenomenon, which determines the final shape and size of architected carbon, and thus influences the properties and final application. The master thesis will aim to study the pyrolysis process under a scanning electron microscope through *in situ* pyrolysis of micro-architected precursors with varied structural complexity.

The specific tasks within the project will be: (i) 3D printing of precursor architectures with increasing structural complexity using microstereolithography; (ii) *in situ* pyrolysis of 3D printed structures; (iii) characterization the shrinkage of the obtained pyrolytic carbon. The student will learn about 3D printing, carbonization, and scanning electron microscopy in the first of the thesis through literature review, introduction to the processes and infrastructure, and running test experiments. In the following month, the student will start fabricating experimental samples, and perform *in situ* pyrolysis. Upon *in situ* experiments, the recording of the experiments will be analyzed through image analysis. The thesis will culminate with an understanding of the structural shrinkage with pyrolysis temperature and structural complexity.

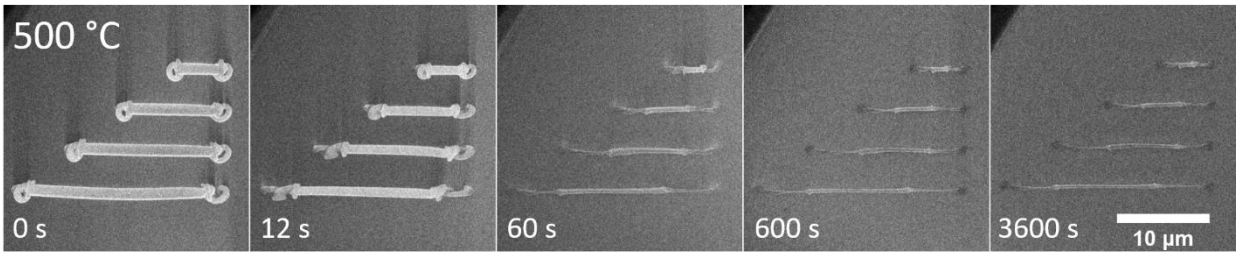


**Figure:** A montage of *in situ* pyrolysis of 3D nano-printed structures, showing the structural evolution over time for an isothermal heating at 500°C.

**Preferred qualification:**

- Preferred background: Materials science, chemical engineering, mechanical engineering, or related field.
- Knowledge about 3D printing processes is preferred.
- Self-motivated, independent thinker, proactive and a team player.
- Good proficiency in English (both speaking and writing).
- Willing to write scientific reports or papers.

**Start date:**
As soon as possible

**Duration of project:**
6-9 months.

**Contact person:**
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