

**DKFZ Site Dresden**  
Smart Technologies for  
Tumor Therapy

**Technical University Dresden**  
Faculty of Medicine Carl Gustav Carus  
Faculty of Electrical & Computer Eng.

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## **DKFZ & DIGS-ILS PhD program**

**Division/group head:** Smart technologies for tumor therapy / Prof. Dr. Tian Qiu

**Direct project supervisor:** Prof. Dr. Tian Qiu

**Project title:** 3D-bioprinting of the lymphatic system for cancer research

### **Summary:**

Lymph nodes (LNs), in association with the lymphatic vessels, act as important stations for immune defense and fluid homeostasis. The role of LNs in various diseases, particularly cancers, has been extensively studied. Yet, there are many fundamental biophysics questions remaining to be answered, for example, how fluidic and solid stresses influence the immune cell dynamics? Can we engineer LNs environment to artificially train immune cells? Emerging in vitro models, such as hydrogels,<sup>[1]</sup> LN-on-a-chip,<sup>[2,3]</sup> and organoids<sup>[4]</sup> have been engineered to mimic lymphatic physiology and prompt a deeper understanding. However, precise modelling of the lymphoid structures and the functionality in vitro remains a big challenge. In this PhD project, we aim to create in vitro lymphatic systems, including vessels and nodes by two-photon polymerization 3D printing and coaxial bioprinting methods. The PhD candidate will fabricate bioink with soft materials, relevant cells and bioactive substance. He or she will apply advanced bioprinting techniques to mimic the in vivo anatomy and dynamic microenvironment, allowing studies of hydrodynamic flows and cell interactions. The developed platform will be a general model to study the lymphatic systems with well-controlled engineering settings, with high potential for the screening of new therapeutic targets, drugs and minimally-invasive methods against cancer.

The project is going to be carried out in the division “Smart Technologies for Tumor Therapy” at DKFZ Site Dresden led by Prof. Tian Qiu, in close collaboration with the Faculty of Medicine and the Faculty of Electrical and Computer Engineering, TU Dresden and the National Center for Tumor Diseases (NCT). The group focuses on smart technologies, especially micro-/nano-robots, for cancer therapies, and there is internal expertise in using advanced 3D printing techniques to create soft micro-structures and to build organ and tumor models.<sup>[5-6]</sup>

### **Foundation under Public Law**

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The lymphatic model developed in this project will also serve as a tool to test and optimize the performance of robots in biological environments. The group offers an attractive working environment with interdisciplinary fields including biomedicine, material science, engineering, artificial intelligence, as well as computational and medical physics. It is a very international group that consists of current members from 6 different nationalities.

#### Desired qualifications:

A Master degree in Biomedical Engineering, Biology, Chemical Engineering, Material Science or relevant fields is required. Interest or experience in the fields of bioprinting, microfabrication, microdevices, soft biomaterials, biomechanics and medical physics is preferred. The suitable candidate should be self-motivated and possess excellent English skills. Open mindedness towards discussing novel ideas and the flexibility to apply various experimental methods (potentially combining different areas of expertise) are favorable.

**Location:** Dresden

#### References:

- [1] Advanced Materials 2024, 36, 2310043.
- [2] ACS Applied Bio Materials 2020, 3, 6697-6707.
- [3] Advanced Science 2024, 11, 2302903.
- [4] Nature Medicine 2021, 27, 125-135.
- [5] Annals of Biomedical Engineering 2021, 49, 2412–2420.
- [6] Annals of Biomedical Engineering 2021, 49, 2139–2149.