# POST-DOCTORAL POSITION

## Dynamic cell-matrix interactions in cancer within controlled 3D fiber arrays

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### Hosting structures

This project will be carried out at **Institut Curie**, a leading French cancer center combining a multidisciplinary research center and hospital, and at **Chimie ParisTech**, a chemistry engineering school and active research center with expertise ranging from synthetic and physical to material chemistry. It will be performed in the frame of a collaborative project between **Sylvie Coscoy** (team Biology-inspired Physics at Mesoscales) and **Vincent Semetey** (team Materials, Interface and Soft Matter). Institut Curie and Chimie ParisTech are both located in the center of Paris, in close proximity, and the project benefits from the **rich infrastructure** of both institutes (state-of-the-art imaging platform, cell culture, microfluidics and microfabrication, modeling of biophysical phenomena; chemical surface characterization and wide expertise in chemistry), with a **two-photon polymerization set-up** specifically dedicated to the project and a **strong collaborative network** for mechanical, imaging and biology aspects.

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### Project

The mechanical, geometrical and chemical properties of the **3D fibrous extracellular matrix** play a key role in cancer initiation and progression, by controlling the movement and fate of tumor cells as well as surrounding fibroblasts, immune or endothelial cells. A strong emphasis has been put recently in the community on the development of matrices with controllable fiber properties, as tools to understand cell mechanical behavior and migration. However, while numerous biomaterials have been engineered to obtain the desired properties at the multicellular scale, controlling the 3D architecture and the chemistry of fibers at a subcellular scale necessitates specific techniques like two-photon polymerization. Our team has developed over the years **a full toolbox to produce at will complex 3D geometries and fiber networks** [1,2], in hybrid polymers, hydrogels or protein materials, which also includes an innovative measurement of 3D traction forces exerted by cells. Our system provides now an ideal tool to understand finely the dynamic adaptation of cell individual and collective migration to the microenvironment, and in particular fundamental aspects of migration behaviors and cell shape changes in tumors.

This project aims to characterize the **dynamic behavior** of cancer cells and surrounding cells, in relation to the fine geometry and to local mechanical and chemical properties of their 3D fiber microenvironments. Two-photon polymerization will be used to build a variety of **3D generic architectures** of fiber grids characteristic of the **tumor extracellular matrix**, like structures with gradients of stiffness, fiber density or different fiber cross-linking. In these different architectures, the migration and migration biases, the global cell and nuclei shape changes, as well as the formation of protrusions and the local forces will be systematically analyzed, and the results integrated in a general framework in link with the local physical and chemical cues of the grid. **Cell lines** studied will be fluorescently-labeled tumor cells models of breast or renal cancer, fibroblasts or cancer-associated fibroblasts, and immune cells. Individual cell behaviors will first be characterized, before the analysis

of collective behaviors, including from tumor spheroids and with interactions between cell populations. **Image acquisition** will be performed by advanced optical tools, spinning disk or Lattice Light Sheet Microscopy. An important part of the project will be to develop from previous tools of the group and from the existing literature **automated image analysis** pipelines to characterize 3D shape changes, and to integrate these results in a general frame.

This project is based on the expertise of the consortium on chemistry, two-photon polymerization and cell dynamics, including image analysis and 3D force measurements. It will highly benefit from synergy with parallel collaborative projects developed in the team about neutrophil and endothelial dynamic organization in various 3D architectures. The system developed, from microstructures to cell dynamic datasets and automated image analysis development, will be of general use for the community, and will pave the way to future applications in the domain of cancer treatments, for example targeting matrix organization.


1. Ucla, P. *et al.* Dynamics of Endothelial Engagement and Filopodia Formation in Complex 3D Microscaffolds. *Int. J. Mol. Sci.* **23**, (2022).
2. Coscoy, S. *et al.* Microtopographies control the development of basal protrusions in epithelial sheets. *Biointerphases* **13**, 041003 (2018).


## Candidate profile

A variety of profiles and PhD backgrounds will be considered for the position: applicants with **PhD either in (bio)physics, biomaterials, cell biology or image analysis** could be a good match for the project.

Postdoctoral funding is available for two years.

## Contacts


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