Roderick Lim researches the transport processes and mechanical properties of cells

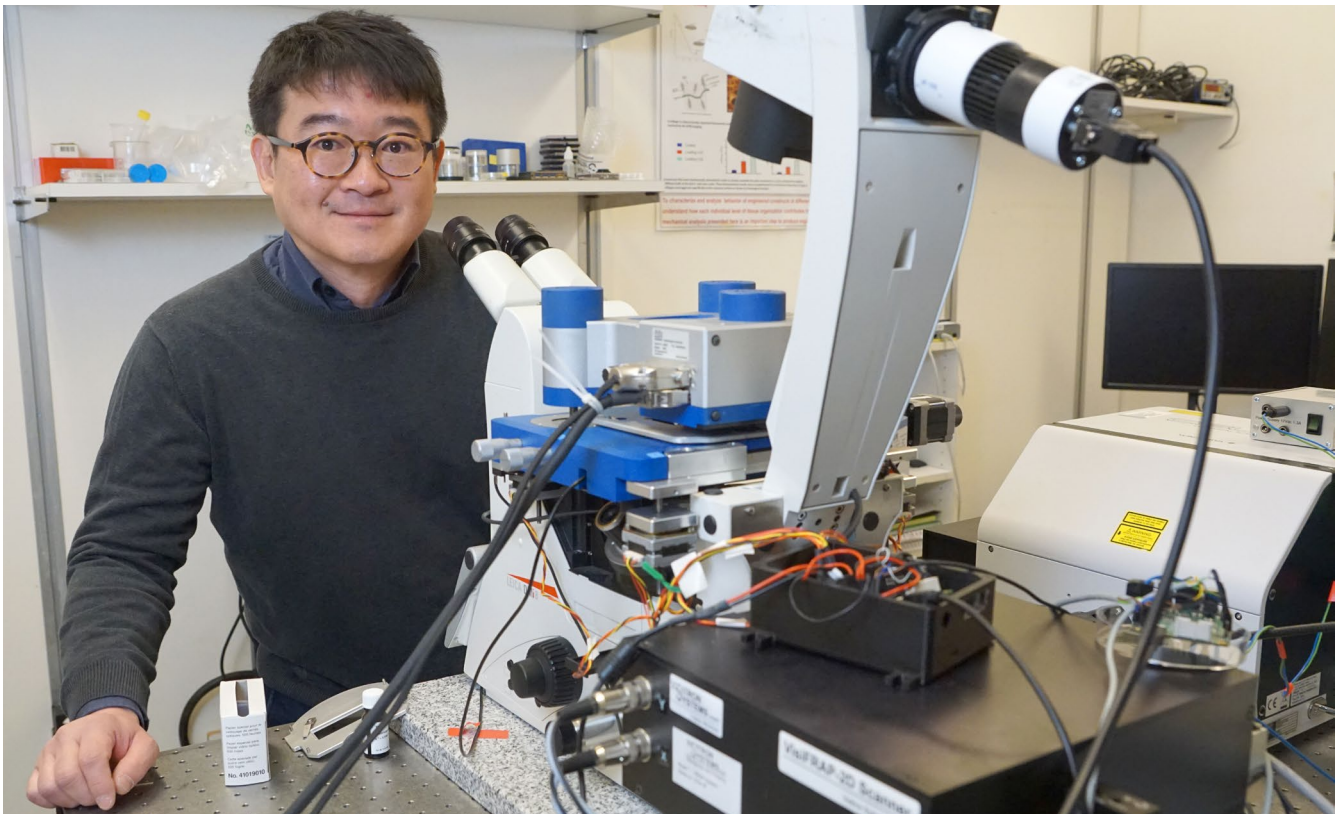
Promising applications form a key part of his research

Argovia Professor Roderick Lim from the Biozentrum at the University of Basel leads a team studying the molecular mechanics and selective transport processes of living cells. Lim believes it is important not only to understand the biological processes but also to keep an eye on potential applications of his findings. Currently, a start-up from his laboratory – ARTIDIS AG – runs its first clinical trial. In addition, Roderick Lim works alongside colleagues to supervise SNI doctoral dissertations whose findings make a key contribution to potential future applications.

Interested in the strength of cells

For many years, Roderick Lim and his team have been using atomic force microscopy to investigate the stiffness of cells in tissues. Their work has revealed that malignant cancer cells differ from healthy cells in terms of their mechanical properties. Realizing that this can be transformed into a rapid, reliable and cost-effective method to diagnose cancer, at the same time as optimizing treatments, Lim together with colleagues Dr. Marija Plodinec and Dr. med. Marko Loparic founded the start-up ARTIDIS AG in 2014.

Based at Technologiepark Basel, Marija Plodinec has led ARTIDIS from strength to strength as the Chief Executive Officer. A key milestone was the launch of its first clinical trial in 2016, which will be closed in 2019 and has been carried out in collaboration with Roderick Lim and Dr. med. Rosemarie Burian at the University Hospital Basel. In this study, the ARITIDIS platform measures over 500 female patient biopsies and its results are compared to clinical, histological and genetic analyses, thereby delivering personalized nanomechanical biomarker results of each patient.



It is important for Roderick Lim to keep an eye on potential applications of his scientific findings.

"This is exemplary of how a private-public partnership can benefit society," explains Lim. "ARTIDIS delivers a diagnosis within just three hours. In addition to that, the quantitative data enables us to predict whether the tumor will form metastases, hence we can optimize treatment accordingly and improve patient outcomes," adds Plodinec.

Vesicles as specific transport containers

A more recent breakthrough that has emerged from the Lim lab in close collaboration with the group of Professor Cornelia Palivan from the Department of Chemistry promises to improve applications in gene therapy. This involves a team effort from both groups, including SNI doctoral student Christina Zelmer who is studying artificial vesicles (polymersomes) that could deliver drug molecules into specific organelles on a highly selective basis.

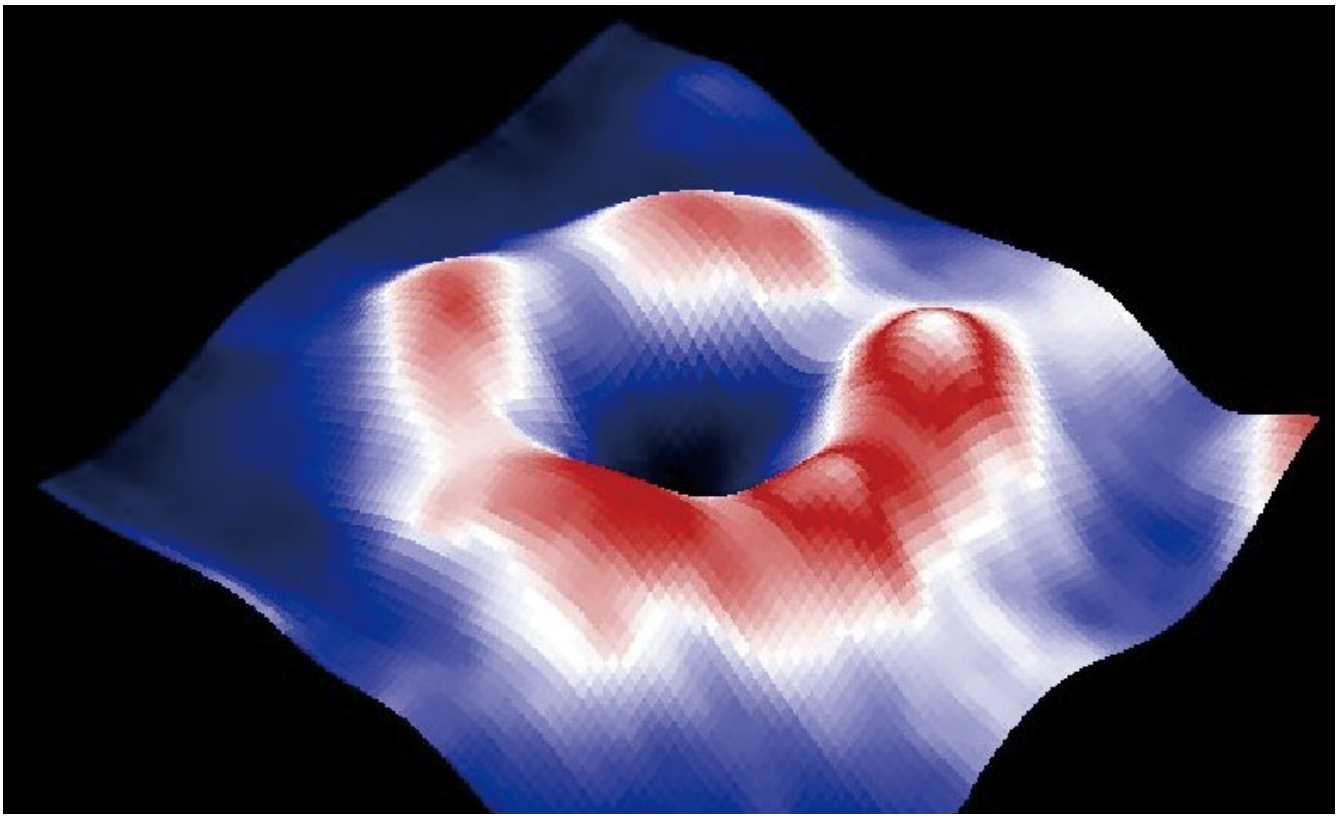
Importantly, Zelmer and colleagues recently managed to create polymersomes that "hijack" the cells internal transport system to enter into the nuclei of living cells, which remain viable even after the polymersomes are "smuggled" in. "This project represents a perfect synergy between both the Lim and Palivan labs. Our success is only possible thanks to our combined understanding of the chemistry of biofunctional polymers, cell biology, and how nuclear pore complexes work," says Roderick Lim in praise of the collaboration.

Artificial nuclear pores

For over a decade, Lim's team has made pivotal contributions to the understanding of nuclear pore complex function. Briefly, these pores are large molecular machines that selectively control transport into and out of the cell nucleus. In 2018, the scientists of the Lim team investigated two key nuclear pore proteins that anchor the rest of the pore complex components to the nuclear envelope.

Using a high-speed atomic force microscope, SNI doctoral student Toshiya Kozai succeeded in visualizing these two proteins and found that they formed nanopores in phospholipid membranes. In the course of his project, which is led by Lim and co-supervised by Professor Ernst Meyer from the Department of Physics, he will attempt to mimic a natural nuclear pore as closely as possible – from the bottom-up – by linking other pore proteins to the established structure.

"In doing so, we will not only expand our understanding of how nuclear pores work, but also converge on some interesting "out-of-the-box" applications in nano- and bio-technology", says Lim.



Two proteins that anchor the rest of the pore complex components to the nuclear envelope are enough to form a nanopore in a phospholipid membrane. (Image: Toshiya Kozai)