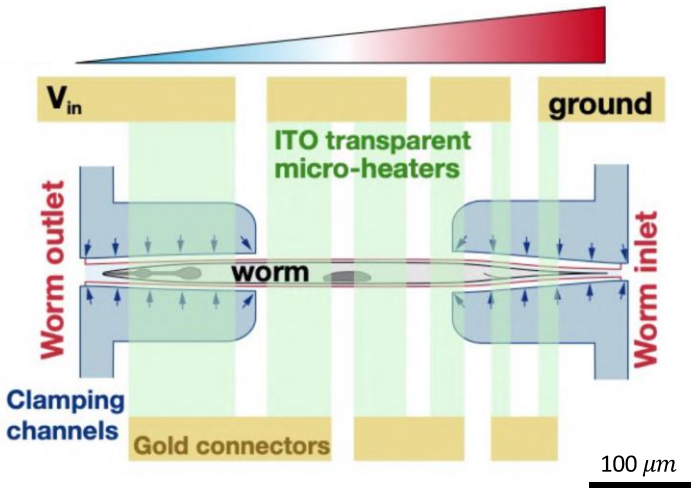
# An optimized transparent micro-resistor pattern for temperature gradient control in microfluidics

M2 Internship proposal

Location: Institut Pierre-Gilles de Gennes / Institut Curie, 75005, Paris
Team/Lab: Quantitative Developmental Biology & IPGG Technology platform
Theme: Nano and Microfabrication
Duration: 6 months
Desired starting date: January or February

## Project:

In this project, we address the question of how multicellular system robustly executes their function in a broad range of environmental temperatures. Our approach is to challenge a small developing multicellular organism (nematode worm) with a **very steep linear temperature gradient** in a microfluidic system and follow its response through live-microscopy. To obtain this steep temperature gradient, we took inspiration from a study by *Selva, Jullien et al. (JMM, 2009)*. All experiments were performed at the platform, at the IPGG. Briefly, we first deposit a layer of ITO (~175nm) then a layer of gold (~300nm) on a coverslip using a sputtering machine. We then use a lift-off process to obtain the pattern of ITO resistors and gold as schematically shown on the right. Finally, by applying a potential difference, a linear temperature profile is obtained by joule effect. This temperature profile will be later quantified through high-resolution infrared microscopy in the laboratory of Prof. Marie-Caroline Jullien in Rennes.




We previously fabricated prototypes of these microfluidic devices. However, further optimizations are necessary to obtain reliable temperature profiles within physiological temperature ranges.

## Goals of the internship:

Getting a well-controlled temperature gradient while reducing the applied voltage to avoid any risk. Therefore, we need to maximize the heat flux:

- Finding the optimized parameters to obtain the lowest possible ITO resistivity.
- Finding the optimized parameters to minimize the total resistance.
- Characterizing the thickness of ITO resistors after the lift-off process and optimizing its reproducibility.

Additionally, and once the fabrication process is mastered, we would like to explore other micropatterns of ITO resistors that, for instance, lead to a step-like temperature profile, rather than a linear gradient.

If you need additional information, please do not hesitate to contact eliot.schlang@curie.fr.