Development of a miniaturized temperature sensor array for biological applications

Richard Ciapala, Microengineering section

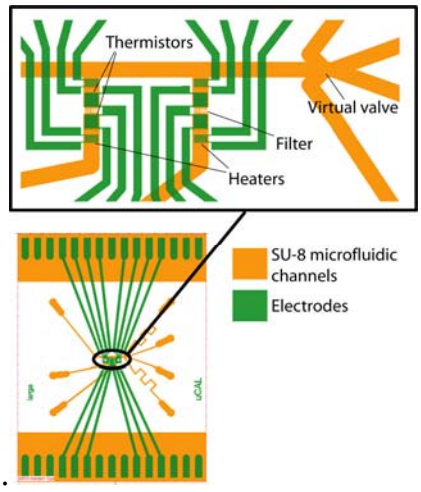
Assistant: *Nicolas Demierre*

Professor: *Renaud Phillipe*

Energy moving from one place to another is called heat and calorimetry uses measurement of temperature change, along with heat capacity to track the movement of heat. The ultimate objective of the device is to develop a sensor able to measure the energy produced by the metabolism of a single cell.

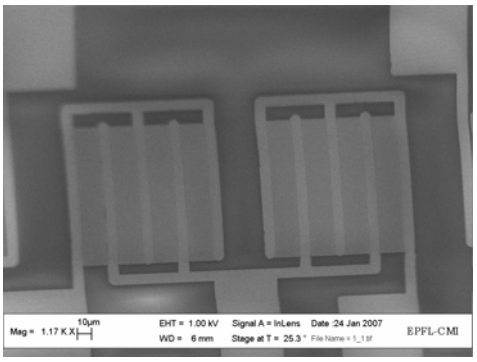
Working on a basis of a developed chip the goal of this project was the implementation of thermistors using a high TCR material such as amorphous germanium. The main objective of using this material is to increase the sensitivity of the microsystem.

Using embedded heaters the microsystem can simulate temperature shifts in its measuring region and a FEM model was developed to characterize the heat flux occurred by these heaters in the system for better calibration and temperature control of the device.



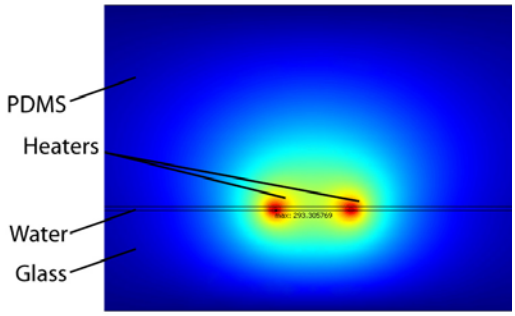
Main parts of the chip

A first step was to characterize properties of thin-film germanium and more particularly its TCR which was evaluated at -2 %/K at room temperature. New thermistors where designed and fabricated. First results showed, as expected, an increase in the sensitivity of the microsystem.



Germanium thermistors

The FEM simulation was done by using the comsol multiphysics software and was a simple 2D model of the chip. The deviation between the model and the measurements were in the order of 25%. The simulation can also help to determine the power on heaters in order to control the temperature in the measuring region.



FEM simulation of microsystem