Centre de Nanosciences & de Nanotechnologies

C2N General Seminar

Friday September 20th 2019 - 10h 00
Amphitheater of C2N

"Microfluidic devices for biomedical applications: from bioanalysis to artificial biomimetic organs"

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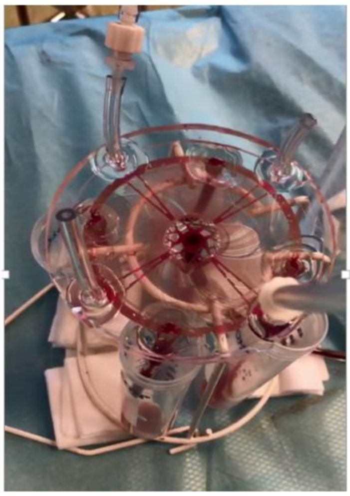
In this talk I will review some examples of microfluidic devices that can handle very small volumes of biological fluid for medical applications.

In the field of biomedical analysis, current macroscopic methods based on chromatography techniques coupled to mass spectrometry remain long and tedious, which may prove detrimental for certain pathologies where a fast and early diagnosis is often desired. On-chip analytical methods are therefore very promising, since analysis can be carried out in 30 minutes with a microliter of biological liquid. In the first part of my talk, I will present two recent examples of bioanalytical chips for the detection of trace biomolecules: 1/ nanofluidic devices allowing enrichment by a factor of 1000 after few minutes in a selective way [1] and 2/ graphene-based biosensors for direct DNA electrochemical detection at the sub-femtomolar level [2-3]. More recently, microfluidics technologies are also used to develop "organs-on-chips" with living cells that are cultured within 3D devices. Concerning this recent emerging field, I will conclude my talk by presenting two novel microfluidic devices. The first one is an artificial lung that exhibits the largest surface area of gas exchange at 4 inches wafer scale [4] compared to previously reported devices. I will show that its oxygen transfer rate is strongly related to the thickness of the thin membrane inserted between both blood capillaries and air microchannels. The second device aims to develop a tumor-on-a-chip as an innovative 3D in vitro model of pancreatic cancer able to recreate the complex physiology of the tumor microenvironment and, more specifically, the blood vasculature around the spheroid.



The 4 inch microfluidic artificial lung during one experiment of blood oxygenation

References :

[1] A-C Louër, A Plecis, A. Pallandre, J-C Galas, A. Estevez-Torres, A-M. Haghiri-Gosnet, Anal. Chem. 85 (2013) 7948−7956

[2] B. Zribi, E. Roy, A. Pallandre, S. Chebil, M. Koubaa, N. Mejri, H. Magdinier Gomez, C. Sola, H. Korri-Youssoufi, A-M Haghiri-Gosnet, Biomicrofluidics 10 (2016) 014115

[3] B. Zribi *et al*, Nanoscale 8 (2016) 15479 and B. Zribi *et al*, Carbon 153 (2019) 557-564

[4] A-M. Haghiri-Gosnet, Lyas Djeghlaf, Julie Lachaux, Alisier Paris, Gilgueng Hwang, European Patent EP18306405.4 (*29 Oct. 2018*) "Microfluidic gas exchange devices and methods for making same"

Anne-Marie Haghiri (CNRS, DR1) is co-leader of the "Microsystems and NanobioFluidics" Department at C2N (UMR9001). She has published 98 peer-reviewed articles (h index=37), 8 book chapters and 5 patents. In the last 10 years, she has coordinated 4 ANR projects and participated to 2 European projects. She is developing "soft" micro/nanostructuration of biocompatible materials for innovative microfluidic platforms as well as organs-on-chip (partner of RHU ANR BioArtLung H2020 project). She has an active interest in on-chip electrophoresis for early diagnosis as well as electrochemical detection of both DNA and proteins.

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