SmartVista Open Day Workshop

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SmartVista Open Day Workshop

LIRMM, Montpellier, France – 15 October 2019

Cardiovascular diseases (CVD) remain the leading cause of mortality and a major cause of morbidity in Europe. Every year there are more than 6 million new cases of CVD in the EU and more than 11 million in Europe as a whole. With almost 49 million people living with the disease in the EU, the cost to the EU economies is €210 billion a year. There is a growing demand for a reliable cardiac monitoring system to catch the intermittent abnormalities and detect critical cardiac behaviors which, in extreme cases, can lead to sudden death. The objective of the Smart Autonomous Multi Modal Sensors for Vital Signs Monitoring (**SmartVista**) project is to develop and demonstrate a next generation, cost-effective, smart multimodal sensing platform to reduce incidences of sudden death caused by CVD, and will contribute to the EU vision of an Internet of Things for healthcare. The key innovation in SmartVista is to integrate 1D/2D nanomaterials-based sensors to monitor the heart, thermoelectric energy harvesters to extract energy from the body to power the system and printable battery systems to store this energy. Together these will result in a self-powered device that will autonomously monitor the electrocardiograph, respiratory flow, oxygen flow and temperature of the patient. This information will then be transmitted wirelessly for online health processing. This real-time self-powered monitoring of a patient’s health is currently not available. Thus, the technology that will be developed in SmartVista will position us at the forefront of digital health and wearable biosensor technology for wireless monitoring in hospitals and of remote patients, both of which are necessary in this era of an aging population. You can find more information about SmartVista project at the website www.smartvista.eu**.**

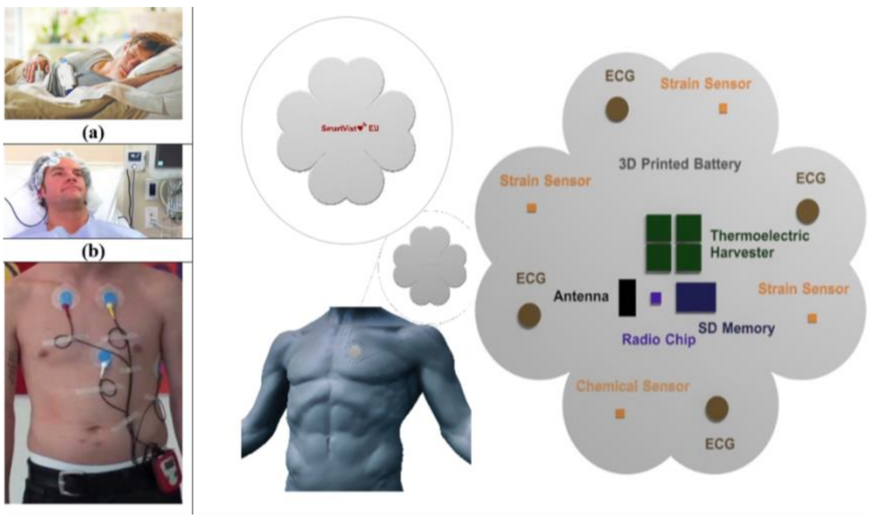

Illustration of SmartVista smart wearable device for continuous health monitoring.

15 October 2019	
09:00 – 09:10	**Arrival & Welcome Note** by *Dr. Aida Todri-Sanial*, CNRS-LIRMM *Location: Bat 4, Salle Seminaire, LIRMM, 161 rue Ada, Montpellier*
09:10 – 10:00	**Soft, Conformable, Large Area eSkin** by *Prof. Ravinder Dahiya* Bendable Electronics and Sensing Technologies School of Engineering, University of Glasgow, UK
10:00 – 10:50	**Surface Enhanced Infrared Absorption Spectroscopy for Molecule Detection** by *Prof. Fernando Gonzalez-Posada Flores* Institut d'Electronique et des Systemes (IES) University of Montpellier
10:50 – 11:00	**Coffee Break**
11:00 – 11:50	**Engineering of Exfoliated 2D Materials: Principles and Applications** by *Prof. Damien Voiry* Institut Europeen des Membranes (IEM) University of Montpellier
11:50 – 12:40	**Surface Nanocomposites for Sensing Applications: CNTs in PEEK** by *Prof. Wolfgang Basca* CEMES-CNRS Université Paul Sabatier
12:40 – 14:10	**Lunch**

ABSTRACTS

Soft, Conformable, Large Area eSkin

Ravinder DAHIYA
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The miniaturization led advances in microelectronics over 50 years have revolutionized our lives through fast computing and communication. Recent advances in the field are propelled by applications such as robotics, wearable systems, and healthcare etc. through More than Moore technologies. Often these applications require electronics to conform to 3D surfaces and this calls for new methods to realize devices and circuits on unconventional substrates such as plastics and paper. This lecture will present various approaches (over different time and dimension scales) for obtaining distributed electronics and sensing components on flexible and conformable substrates, especially in context with tactile or electronic skin (eSkin). These approaches range from distributed off-the-shelf electronics integrated on flexible printed circuit boards, to advanced alternatives such as eSkin by printed nanowires, graphene and ultra-thin chips, etc. The technology for such sensitive flexible (and possibly

stretchable) electronic systems is also the key enabler for numerous emerging fields such as internet of things, smart cities and mobile health etc. This lecture will also discuss how the flexible electronics research may unfold in the future.

Surface enhanced infrared absorption spectroscopy for molecule detection

Fernando Gonzalez-Posada Flores
Institut d'Electronique et des Systemes, Montpellier

Making the right diagnosis in the case of illness is a crucial but not an easy task. Generally, it relies on invasive medical testing. Eventually, patient's medical status is related to pollutants in their environment. Optical lab-on-chip have recently emerged as a technique to identify moieties of molecule quantities notably in human laboratory analysis. Better and precise information from biological samples need information from a broadband spectral range. Molecules absorb light from the visible to far-IR spectral region. In this presentation, I will summarized the design, fabrication and characterization of sensitive semiconductor structures to address mid-IR range and cover the fingerprint region of molecules [1,2,3].

References:

[1] F. Bahro, F. Gonzalez-Posada, M.J. Milla Rodrigo, M. Bomers, L. Cerutti, E. Tournié and T. Taliercio, Nanophotonics 2018, 7(2), 507-516
[2] Mario Bomers, Aude Mezy, Laurent Cerutti, Franziska Barho, Fernando Gonzalez-Posada Flores, Eric Tournié, Thierry Taliercio, Applied Surface Science 2018, 451, pages 241-249
[3] Franziska B. Barho, Fernando Gonzalez-Posada Florès, Aude Mezy, Laurent Cerutti, Thierry Taliercio, ACS photonics 2019, 6, 1506

Engineering of exfoliated 2D materials: principles and applications

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Among the family of 2D materials, transition metal dichalcogenides (TMDs) are intensively investigated for opto-electronic and electro-catalytic applications1,2. The properties of TMDs can be largely tuned by changing their elemental composition, their thickness and their atomic structure1. TMDs can adopt two different coordinations for the metal atoms: either a trigonal prismatic or an octahedral coordination corresponding to 2H and 1T phases respectively that can eventually induce dramatic changes in the electronic behavior of the nanosheets3. Besides phase engineering, the properties of 2D materials can be tuned by changing the defect concentration such as sulfur vacancies.

In addition we have recently demonstrated that TMD nanosheets can be covalently functionalized which opens new avenues for controlling the surface chemistry and the opto-electronic properties of exfoliated TMDs4. Through several examples, I will present strategies for engineering exfoliated 2D materials via phase, defect and functionalization. My presentation will highlight how these strategies can be used for fine tuning the properties of the 2D TMDs and other 2D materials for optoelectronics,
electrocatalysis and molecular sieving.

References:

1. Wang, Q. H., Kalantar-Zadeh, K., Kis, A., Coleman, J. N. & Strano, M. S. Electronics and optoelectronics of two-dimensional transition metal dichalcogenides. Nat. Nanotechnol. 7, 699–712 (2012).

2. Voiry, D., Yang, J. & Chhowalla, M. Recent Strategies for Improving the Catalytic Activity of 2D TMD Nanosheets Toward the Hydrogen Evolution Reaction. Adv. Mater. n/a-n/a (2016). doi:10.1002/adma.201505597
3. Voiry, D., Mohite, A. & Chhowalla, M. Phase engineering of transition metal dichalcogenides. Chem. Soc. Rev. 44, 2702–2712 (2015).
4. Voiry, D. et al. Covalent functionalization of monolayered transition metal dichalcogenides by phase engineering. Nat. Chem. 7, 45–49 (2015).

Surface nanocomposites for sensing applications : CNTs in PEEK

Guillaume Pillet, Pascal Puech, Wolfgang Bacsa
CEMES-CNRS and University of Toulouse

The formation of uniform dispersions from agglomerated carbon nanotubes in polymers is a major challenge for their use in composites. We show that agglomerated carbon nanotubes on top of PEEK, a high performance thermoplastic polymer, are efficiently incorporated into the surface when annealing. Annealing is found to disperse carbon nanotubes surprisingly well and a surface composite of about 200 nm thickness is formed. The tube dispersion is found to depend on tube type (multi, double or single walled). Electrical resistance measurements at perculation show strong sensitivity to deformation and are reversible for small deformations. We believe that controlled dispersion on the surface of a thermoplastic polymer is a promising system for sensing applications.