UNIVERSITÉ DU
LUXEMBOURG

Special Colloquium
Monday 23rd March 2020
at 4:00 pm
Campus Limpertsberg
Bâtiment des Sciences - Room BS 2.01
Talk by Professor David Leigh - FRS FRSE FRSC MAE

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invited by Professor Massimiliano ESPOSITO

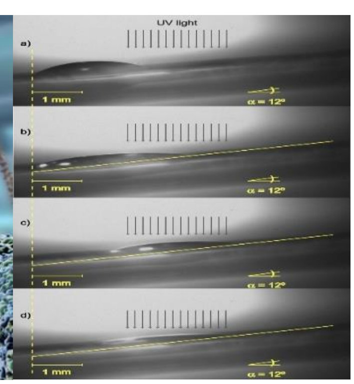
Prof. Esposito would like to emphasize that David Leigh was suggested as one of three candidates for the potential award of a Nobel Prize for synthetic molecular machines in 2016.
He is also well known for his excellent and entertaining presentations

Making the Tiniest Machines

"We are at the dawn of a new industrial revolution of the twenty-first century, and the future will show how molecular machinery can become an integral part of our lives. The advances made have also led to the first steps towards creating truly programmable machines, and it can be envisaged that molecular robotics will be one of the next major scientific areas."[1]

The 2016 Nobel Prize in Chemistry Committee, October 2016Systems

Over the past few years some of the first examples of synthetic molecular level machines and motors—all be they primitive by biological standards—have been developed.[2-7] These molecules respond to light, chemical and electrical stimuli, inducing motion of interlocked components held together by hydrogen bonding or other weak molecular interactions. Recently the first programmable systems have been developed [4-5] the forerunners of a new technological era of molecular robotics.
Perhaps the best way to appreciate the technological potential of controlled molecular-level motion is to recognize that nanomotors and molecular-level machines lie at the heart of every significant biological process. Over billions of years of evolution Nature has not repeatedly chosen this solution for achieving complex task performance without good reason. In stark contrast to biology, none of mankind's fantastic myriad of present day technologies exploit controlled molecular-level motion in any way at all: every catalyst, every material, every plastic, every pharmaceutical, every chemical reagent, all function exclusively through their static or equilibrium dynamic properties. When we learn how to build artificial structures that can control and exploit molecular level motion, and interface their effects directly with other molecular-level substructures and the outside world, it will potentially impact on every aspect of functional molecule and materials design. An improved understanding of physics and biology will surely follow.



[1] The Nobel Prize in Chemistry 2016–Advanced Information. Nobelprize.org. Nobel Media AB 2014. Web. 6 Oct, 2016, http://www.nobelprize.org/nobel_prizes/chemistry/laureates/2016/advanced.html. [2] E. R. Kay and D. A. Leigh, *Angew. Chem. Int. Ed*., 2015, **54**, 10080. [3] B. Lewandowski, et al., *Science*, 2013, **339**, 189. [4] S. Kassem, A. T. L. Lee, D. A. Leigh, A. Markevicius and J. Solá, *Nat. Chem.*, 2016, **8**, 138. [5] S. Kassem, A. T. L. Lee, D. A. Leigh, V. Marcos, L. I. Palmer and S. Pisano, *Nature*, 2017, **549**, 374. [6] S. Erbas-Cakmak, S. D. P. Fielden, U. Karaca, D. A. Leigh, C. T. McTernan, D. J. Tetlow and M. R. Wilson, *Science*, 2017, **358**, 340. [7] M. R. Wilson, J. Solá, A. Carlone, S. M. Goldup, N. Lebrasseur and D. A. Leigh, *Nature*, 2016, **534**, 235.

Biography:

David Leigh is one of the pioneers of synthetic molecular machinery. Landmark examples from his laboratory include the first synthetic Brownian ratchet molecular motors [*Nature* **2003**, *424*, 174; *Nature* **2007**, *445*, 523] and the first reversible synthetic molecular motor [*Science* **2004**, *306*, 1532]. His group created the first synthetic molecular machines able to perform macroscopic work [*Nat. Mater*. **2005**, *4*, 704], invented the first artificial small-molecule motors that, like motor proteins, 'walk' along tracks [*Nat. Chem*. **2010**, *2*, 96] and have developed some of the first molecular machines having truly complex mechanisms of operation, such as a small-molecule machine that synthesizes peptides of specific sequence in a manner reminiscent of the ribosome [*Science* **2013**, *339*, 189; featured in '*Breakthroughs-of-the-Year 2013*' *Science* **2013**, *342*, 1441]. In the past few years his group have reported the first examples of autonomous chemically-fuelled molecular motors (*Nature* **2016**, *534*, 235), used knotting in a molecule to induce allosteric catalysis (*Science* **2016**, *352*, 1555), synthesized the most complex molecular knot to date (*Science* **2017**, *355*, 159; featured in the 2019 Guinness Book of World Records), introduced the concept of 'small-molecule robotics' (*Nat. Chem.* **2016**, *8*, 138) and developed a programmable 'molecular assembler', described in an accompanying News & Views article as '*Science fiction becomes fact*' (*Nature* **2017**, *549*, 374).

Leigh has received a number of national and international scientific awards, including the Royal Society of Chemistry (RSC) Prizes for Supramolecular Chemistry (2003), Nanotechnology (2005) and the Tilden (2010) and Perkin (2017) Awards, the Spanish Chemical Society (RSEQ) Prize for Chemistry (2007), the Institute of Chemistry of Ireland Award for Chemistry (2005), the Feynman Prize for Nanotechnology (2007), the Izatt-Christensen Award in Macrocyclic Chemistry (2007), the EU Descartes Prize for Transnational Research (2007), the Royal Society Bakerian Medal (2013) and the ISNSCE (International Society for Nanoscale Science, Computation and Engineering) Nanoscience Prize (2019). He is the recipient of three successive ERC Advanced Grants (2008, 2013, 2018) and was elected a Fellow of the Royal Society (FRS) in 2009. He is a Royal Society Research Professor at the University of Manchester and a 1000 Talents Professor at East China Normal University, Shanghai.