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Monday, July 24th

15:30 pm Assembly Hall

Prof. Michael Booth
Department of Chemistry,
University College London, UK

Dr. Sonia López
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The Royal Society

Gobierno de España
Ministerio de Ciencia e Innovación

Remote-controlled nucleic acids for biology and medicine

Prof. Michael Booth

Department of Chemistry,
University College London, UK

Abstract

DNA and RNA form the basis for many therapeutic and experimental technologies, including gene editing and silencing, several aspects of nanotechnology, aptamers and their applications, and cell-free protein expression. It would be advantageous to control the function of these technologies, as this would greatly expand their application in biology and medicine by reducing toxic on/off-target effects and systemic toxicity. The main focus of our research is the generation of remote-controlled nucleic acids under the control of various biologically- and medically-applicable stimuli, including temperature, magnetism, and multiple wavelengths of light. We are also exploring several applications of these nucleic acids, for instance to control communication of synthetic cells with living cells and gene delivery and knockdown. In the future, our universal chemical method for controlling DNA and RNA structure and function may form the basis of controllable therapeutics and new technologies for basic research.

Biography

Prof. Booth studied for an MChem degree at the University of Southampton (UK), which included research projects in the groups of Professor Martin Grossel, Professor Ali Tavassoli, and Professor George Attard. He carried out his PhD at the University of Cambridge (UK) under the supervision of Professor Sir Shankar Balasubramanian, developing sequencing techniques for modified cytosine bases. He then worked in the group of Professor Hagan Bayley at the University of Oxford (UK) as a postdoctoral researcher and Junior Research Fellow at Merton College, Oxford. At Oxford, he developed light-activated DNA technology to control cell-free protein expression within synthetic cells. Prof. Booth started his independent research career in 2018 with a Royal Society University Research Fellowship in the Department of Chemistry at the University of Oxford. In 2022, he moved to the Department of Chemistry at University College London to begin a Lectureship in Organic Chemistry and Chemical Biology (https://boothlab.uk/). His team is an interdisciplinary research group utilising techniques from organic/inorganic synthesis, chemical biology, biochemistry, synthetic biology, and molecular and cellular biology Some representative publications of his research: (1) J.M.Smith, D.Hartmann, M.J.Booth* (2023) “Engineering cellular communication between light-activated synthetic cells and bacteria”. Nature Chemical Biology, In press. (2) G.Mazzotti, D.Hartmann, M.J.Booth* (2023) “Precise, orthogonal remote-control of cell-free systems using photocaged nucleic acids”. Journal of the American Chemical Society, 145, 17, 9481. (3) D.Hartmann, R.Chowdhry, J.M.Smith, M.J.Booth* (2023) “Blue light-activatable DNA for remote control of cell-free logic gates and synthetic cells”. Journal of the American Chemical Society, 145, 17, 9471. (4) M.J.Booth*, V.Restrepo-Schild, A.D.Graham, S.N.Olof, H.Bayley (2016) “Light-activated communication in synthetic tissues”. Science Advances. 2 (4), e1600056. (5) M.J.Booth, E.Raiber, S.Balasubramanian* (2014) “Quantitative sequencing of 5-formylcytosine in DNA at single-base resolution”. Nature Chemistry. 6 (5), 435-440. (6) M.J.Booth… W.Reik, S.Balasubramanian* (2012) Quantitative sequencing of 5-methylcytosine and 5-hydroxymethylcytosine at single-base resolution. Science. 336 (6083), 934. In addition, he has been awarded with multiple recognitions such as the Biochemical Society Early Career Research Award: Biotechnology (2019), SCG Innovation Fund: Young Researcher Award (2018-19) or Oxford Maths, Physical and Life Sciences Impact Awards.

Light controlling gene expression

Dr. Sonia López

Department of Chemistry,
University College London, UK

Abstract

One of the most important biological processes is the expression of a gene to a protein. The use of light to control the gene expression offers unparalleled spatiotemporal resolution from an external, orthogonal signal. Several methods that use light to control the steps of transcription and translation of specific genes into proteins, have been designed, for cell-free to in vivo biotechnology applications. These methods use techniques ranging from the modification of small molecules, nucleic acids and proteins with photocages, to the engineering of proteins involved in gene expression using naturally light-sensitive proteins. Most of the current technologies are employing ultraviolet light, but the aim of our work is the development of photocages activated by near-IR (NIR) light which will enable new approaches for spatial and temporal control of gene expression with higher tissue penetration and less cellular damage.

Biography

Sonia graduated in pharmacy from the UV, after completing her master's studies in Research and Rational Use of Medicines, she did a 2-year stay at the Institute of Organic Chemistry of the Friedich-Alexander University Erlangen-Nurnberg under the supervision of Prof. Svetlana B. Tsogoeva. In 2018 he completed his doctoral studies in chemistry at the UV. He joined the Supramol group in 2021 as a postdoc and she is now at University College London as Postdoc Researcher Associate in the group of Dr. Michael J. Booth.