Unravelling Hidden Abilities Encoded in the Structure of DNA

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Abstract

DNA molecule continues to surprise us with new abilities encoded in its structure. I will overview some of the latest findings of the theory and experiments related with the structural effects on DNA-DNA interactions is solutions, with a focus on (i) DNA condensation and DNA mesophases, and (ii) the ability of homologous genes to recognize each other from a distance prior homologous recombination. The latter will be the main point of the talk, as it refers to one of the great mysteries of molecular genetics: how two homologous genes find each other in the genomic haystack. I will emphasize new experiments performed at Imperial College and Harvard University, which bring new light on this fascinating ability. The talk will summarize activities of a large team of people, including groups at NIH (S. Leikin), Imperial (J. Baldwin, J. Seddon, D.J. Lee, T. Abrecht, A. Wynveen, and AAK); Harvard (M. Prentiss, C. Danilowicz), University of Minnesota (A. Wynveen) and few others.

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Biography

Alexei A. Kornyshev graduated in 1970 from the Moscow Engineering Physics Institute with masters in Theoretical Nuclear Physics. He matured as a scientist at the Frumkin Institute of Electrochemistry (Acad. Sci.) in Moscow, where he did there his Ph.D. (1974) in Theoretical and Mathematical Physics and D.Sc. in Chemistry (1986), having worked there till 1991. In 1992 he was invited to Research Centre Jülich, Germany, to lead a Theory Division in the Institute for Materials and Processes in Energy Systems, a position combined later with Professorship of Theoretical Physics at the University of Düsseldorf. In 2002 he joined Imperial College where he holds a Chair of Chemical Physics since then.
His interests span widely in theoretical condensed matter chemical physics and its application to electrochemistry, nanoscience, biological physics and energy research. An author of >280 original, refereed papers published in physics and chemistry journals, and >30 monographic/feature articles and book-chapters, he is known by his works in the theory of solvation; solid-liquid and liquid-liquid electrochemical interfaces (including functionalised interfaces); electron and proton transfer in complex environment (including membranes and complex electrodes) and single molecules; physical theory of fuel cells; electrochemical optical metamaterials, ionic liquids and their applications, and *interaction, recognition and assembly of biomolecules*, and *DNA biophysics*. In the latter area, he has performed a series of works published together with S. Leikin (NIH) resulted in what is known as Kornyshev and Leikin theory, developed further later with his co-workers, D.J. Lee and A. Wynveen, et al. His talk will represent achievements in that area.

He was a recipient of 1991 Humboldt Prize in Electrochemistry, 2003 Royal Society Wolfson Award, 2003 Schönbein Silver Medal, 2007 RSC Barker Medal, RSC 2010 Interdisciplinary Prize, 2017 Lynden-Bell Award. He is a Fellow of IUPAC, Institute of Physics, Royal Society of Chemistry, Royal Society of Biology, International Society of Electrochemistry, Foreign Member of the Royal Danish Academy of Science, and Advisory Professor at HUST, Wuhan, China. He leads the Chemical Physics Panel of *Scientific Reports*, and is a Board Member of *J. Physics Condensed Matter*, *ChemElectroChem*, and *Current Opinion in Electrochemistry*.