

MRSEC SEMINAR SERIES

Synthesis and Applications of Molecular 2D Materials

After the demonstration of a variety of inorganic two-dimensional (2D) materials (graphene, hBN, MoS₂, etc.), molecular 2D materials have attracted a significant research interest as well. However, the direct synthesis of these materials is an exceptionally challenging task for chemists. In this contribution, a simple and robust physical method for the synthesis of molecular 2D materials will be presented, which is based on *low-energy electron induced chemical reactions* in aromatic molecular layers. In this way, ultrathin (~1 nm) molecular nanosheets with adjustable chemical and physical properties called Carbon Nanomembranes (CNM) can be prepared [1-4]. Moreover, the method enables synthesis of various other 2D organic-inorganic hybrids [5-6] (e.g., MoS₂-CNM, graphene-CNMs lateral heterostructures, etc.) or ~20 nm thick nanosheets of organic semiconductors [7]. In this talk I will present mechanisms of this electron irradiation induced synthesis and functional properties of the synthesized molecular 2D materials including such examples as their flexible functionalization, photocatalytic properties and applications in the field-effect transistors and biosensors for highly sensitive and specific medical diagnostics of biomarkers.

References

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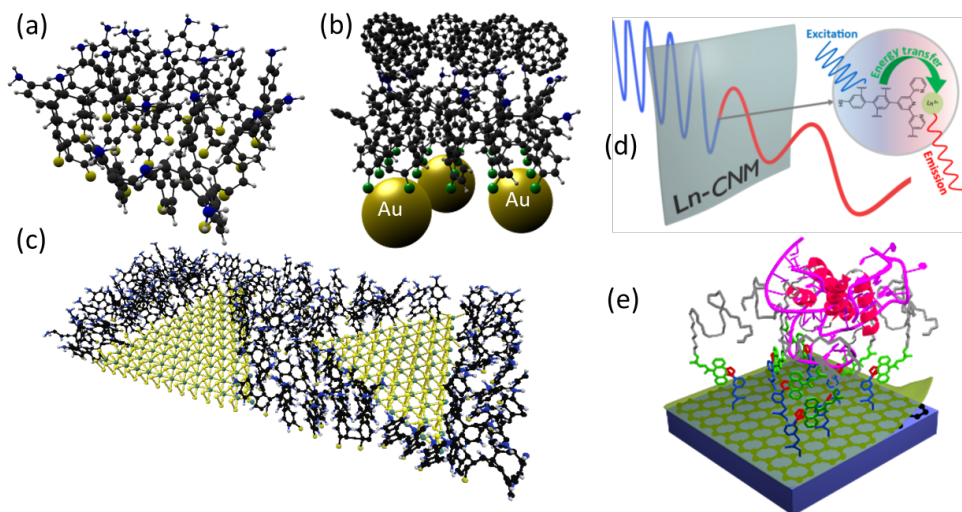


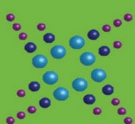
Figure 1: (a) Molecular nanosheet – Carbon Nanomembrane. (b) Vertical organic-inorganic heterostructure. (c) Lateral organic-inorganic heterostructure. (d) Photoactive 1 nm thick nanomembrane. (e) Hybrid structure for ultrasensitive and specific biosensors.

Andrey Turchanin studied physics and materials science at the National University of Science and Technology (MISiS), Moscow (Ph.D. 1999). In 2000 he moved to the University of Karlsruhe with an Alexander von Humboldt Fellowship. 2004-2014 he joined the Faculty of Physics at the University of Bielefeld where he completed his habilitation in Experimental Physics in 2010. In 2012 Turchanin was awarded a Heisenberg Fellowship of the German Research Foundation (DFG) and in 2013 the Bernhard-Heß-Prize of the University of Regensburg for his research in the field of emerging 2D materials. Since 2014 he is a professor of physical chemistry at the Friedrich Schiller University Jena, where he is leading the group of “Applied Physical Chemistry & Molecular Nanotechnology”.



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