Condensed Matter Physics Seminar Series

Two-Dimensional Charge-Density-Wave Quantum Devices

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The early work on charge density waves (CDW) was focused on materials with quasi-one-dimensional (1D) crystal structures that reveal a Peierls transition and CDW sliding at low temperatures. Recently, it was found that some quasi-two-dimensional (2D) transition metal dichalcogenides exhibit unusually high transition temperatures to different CDW phases. In this talk, I will describe our research on 1T polytype of TaS_2 that has the transition between the nearly-commensurate (NC-CDW) and incommensurate (IC-CDW) phases at ~350 K. I will discuss voltage-controlled oscillators, their radiation hardness, possibilities of the electric gate control and practical applications of such CDW quantum devices, which operate at room temperature [1-4]. In addition, I will describe our experiments with "quantum composites" – disordered polymer materials with 1T-TaS_2 used as fillers to achieve new macroscopic functionalities [5]. If time permits, I will also talk about revisiting the CDW "broadband noise" issues in nanowires made of $NbSe_3$ quasi-1D CDW material [6].

Alexander A. Balandin is a distinguished professor and vice chair at the Department of Materials Science and Engineering at UCLA. His current research interests include 1D and 2D van der Waals quantum materials, low-frequency electronic noise in materials and devices, Brillouin-Mandelstam-Raman optical spectroscopy, and emerging quantum devices and technologies. Professor Balandin is a recipient of The MRS Medal from the Materials Research Society and The Brillouin Medal from the International Phononics Society for the discovery of unique thermal properties of graphene and development of the graphene-based thermal management technologies. He received The Pioneer of Nanotechnology Award from the IEEE Society for his nanotechnology and phonon engineering research. He is an elected Fellow of MRS, APS, IEEE, OSA, SPIE, AAAS; and a current Vannevar Bush Faculty Fellow (VBFF). He serves as a Deputy Editor-in-Chief of the Applied Physics Letters.

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4-330 PAB