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NANOSCIENCE COLLOQUIUM

2D Semiconductor Materials for Next Generation Electronics

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Abstract: 2D semiconductor materials represent thinnest semiconductors with novel properties, such as sizable band gaps, high flexibility and temperature independent mobilities. Since the discovery of graphene, one monolayer of carbon, in 2004 2D materials have achieved an rapid progress in material preparation, property exploration and device applications.

First in this talk I will discuss the opportunities and challenges of graphene for new device concepts by the example of an ballistic rectifier, which is based on a combination of the lateral device geometry, high charge carrier mobility and thinness. The zero bandgap of graphene makes it difficult for use as semiconductor materials in logical applications. Instead, graphene can be a suitable material for transparent electrodes in flexible electronics. Thus, I will show that graphene electrodes used in solution-processed metal-oxide thin-film transistors (TFTs) can exceed the properties of reference TFTs with conventional metal electrodes taking into account the device architecture, optimal conversion conditions and suitable passivation layers. Finally, flexible TFTs based on transmission metal dichalcogenides, will be discussed. Since the device praparation based on exfoliated films is not suitable for reproducible transistor and circuit fabrication and future scalable integration all results are presented on large-area grown 2D materials.

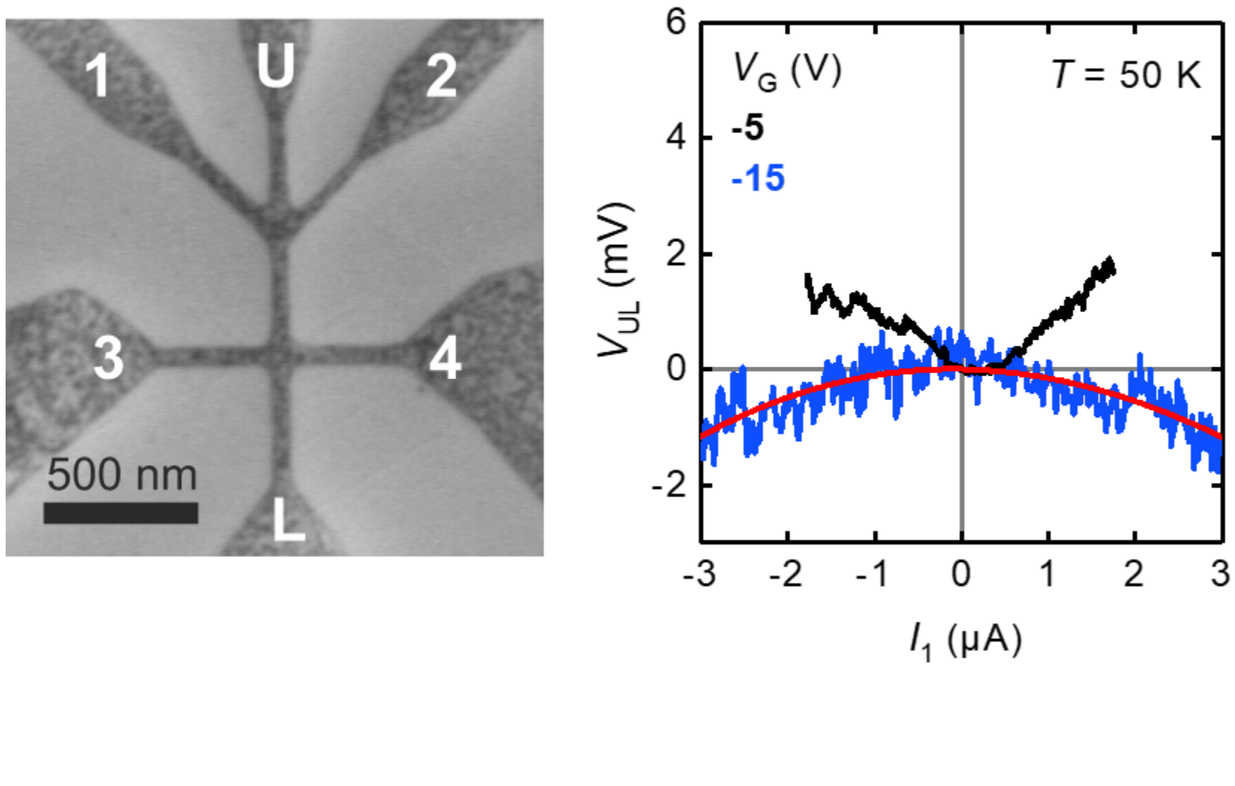

Figure 1: Left: Scanning electron mirograph of an ballistic rectifier based on epitaxial graphene. Right: the rectified output voltage with respect to the input current I1.

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