PHELIQS/CEA Grenoble

Postdoctoral position - 2026-2028

Quantum electronic transport in semiconducting epigraphene

Graphene on Silicon carbide was envisioned very early as a viable route to the use of graphene as it allows the growth of very large crystals. However, the semi-metallic nature of electronic dispersion in graphene intrinsically prevents it's use in microelectronics. On the Si face of silicon carbide, graphene grows on top of a first layer which has the same honey comb lattice as graphene but which is covalently bonded to SiC. This layer is semiconducting and has recently been shown to have a large mobility raising interest for its use in micro-electronics [1]. So far, the electronic properties of this so called semiconducting epigraphene (SEG) have only been studied at relatively elevated temperatures (above 77 K). The present project therefore aims at extending the investigations down to millikelvin temperatures. In particular, the project aims at investigating the quantum electronic properties of SEG, which will manifest in this temperature range.

The postdoctoral researcher to be hired will explore these by transport and tunneling spectroscopy experiments at millikelvin temperatures. She/he will develop field effect devices in combination with Aharonov-Bohm geometries to determine the electronic phase coherence time. Further, in collaboration with our partner at GeorgiaTech, the candidate will evaluate the ability to form high-quality superconducting interconnects, leading to SEG-based Josephson field-effect transistors (JoFETs). Eventually, low-temperature scanning tunneling microscopy and spectroscopy experiments will provide insights into spatially resolved electronic properties of SEG, as well as a variety of SEG-based 2D heterostructures.

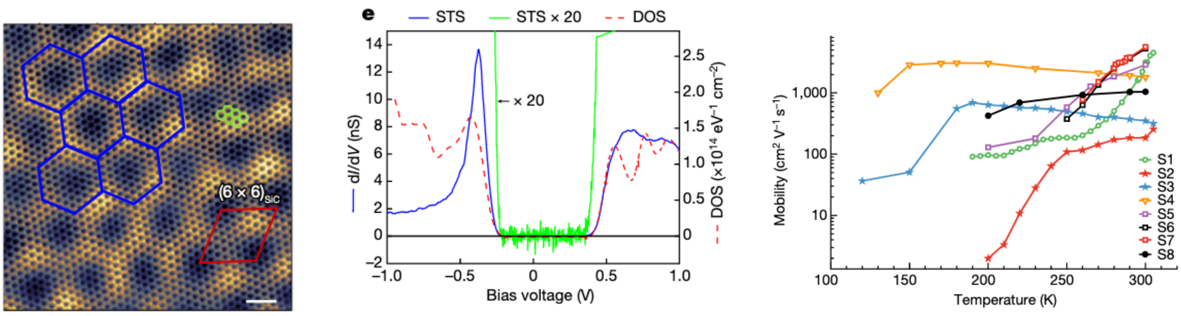

Figure 1 : (left) STM topograph of SEG grown on SiC showing high structural coherence. (center) Tunneling spectroscopy on SEG, revealing a hard semiconducting gap of 600 meV, in agreement with calculations (dashed line). (right) Hall mobility of several SEG samples near room temperature, exceeding several thousand of cm²/V.s, a record value for 2D semiconductors. All data from [1].

The project consortium brings together the team at GeorgiaTech that discovered SEG in 2024 and the Lateqs (Quantum electronic transport) team at CEA Grenoble, who have a long-standing collaboration on the quantum transport properties of graphene on SiC [2,3]. The experimental work is at the interface between surface science and quantum transport studies. The researcher to be hired will develop a fine expertise in state-of-the-art nanofabrication processes, dilutionrefrigerated transport experiments and scanning tunneling microscopy. All necessary experimental facilities are readily available in the host group.

[1] Zhao *et al.,* Nature **625**, 60 (2024).
[2] De Cecco *et al.,* Nano Lett. **20**, 3786 (2020).
[3] Prudkovski *et al.,* Nat. Commun. **13**, 7814 (2022).

Collaboration and networking: This work is supported by ANR via project *Epinel*. It bases on an experimental collaboration between PHELIQS/CEA (C. Winkelmann, V. Renard) and GeorgiaTech (C. Berger, W. de Heer).

Required skills: PhD in Physics or Applied Physics. Prior experience in at least one of the following fields is required: scanning probe microscopies, low temperature physics or nanoelectronics.

Starting date: 2026 (24 months)

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