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Electron transfer at graphene edge electrodes: tunneling, electrochemistry and future applications

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Graphene has the potential of becoming a featuring material in the field of single molecule recognition owing its electronic and structural properties. Our line of research is making progress toward this goal by developing techniques that allow the investigation of graphene edge physicochemical properties. Recently, we have demonstrated electron tunneling in an atomic-sized tunneling junction between two graphene twisted edges [1]. We have also shown electrochemical activity of graphene edge electrodes embedded in a polymeric matrix by perfectly smoothing the faces of the graphene-polymer block [2]. In a separate work, we created zero-depth nanocapillaries by dissolving two crossing nanorods supported by a polymeric matrix. The use of these nanocapillaries as single-molecule sensing was demonstrated by measurement of current blockades induced by DNA translocation events [3]. In this talk, we explain how we combine our previous work to create a zero-depth tunneling nanocapillary for single-molecule recognition. By extending our fabrication method [2], we aim to create a four-electrode graphene tunneling junction separated by a few nanometers (Scheme 1). Simultaneously, we continue to investigate the electrochemical functionalization and characterization of graphene edge electrodes to be used in single-molecule recognition tunneling.

References

[1] Amedeo Bellunato, et al. *Nano Lett.*, 18 (2018) 2505-2510
[2] Amadeo Bellunato and Grégory Schneider. *Nanoscale,* 10 (2018) 12011-12017
[3] Hadi Arjmandi-Tash, et al. *Adv. Mater.* 30 (2018) 1703602

Figures

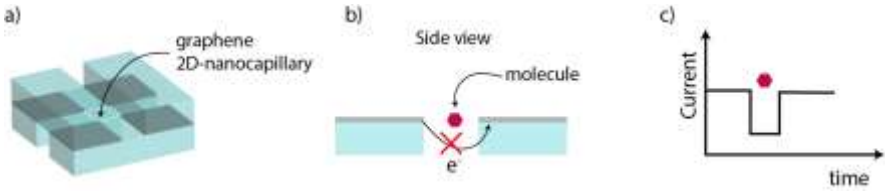

Figure 1: a) Cartoon of a graphene 2D-nanocapillary in a polymer block. b-c) Representation of tunneling current blockade by a molecule between two graphene edges.