Opportunities for swift heavy ion irradiation of graphene at RBI

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Material modifications due to the swift heavy ion impact are primarily governed by density of deposited energy, which is directly proportional to the ion energy loss (stopping power). However, the energy loss of the swift heavy ion is non-linear function of the ion total kinetic energy, and this opens up very interesting possibilities for materials modifications using swift heavy ion beams delivered by small and medium accelerator facilities.

Graphene as the most prominent 2D material is clearly a first choice for ion irradiation studies. Experiments with such thin material are challenging, and improvements in technical capabilities are needed. In the present contribution, we present two such advances implemented at the Ruđer Bošković Institute.

Support graphene needs in filtration applications [1] has to be polymer film of sufficient thickness to provide graphene a mechanical stability over macroscopic scales. In order to punch a hole through such graphene-polymer composite, quite high energies are needed that are not readily available. This can be achieved using high charge state of the ion beam, but at the expense of the low ion current.

Next challenge is related to reactivity of ion irradiation induced defects in graphene when exposed to ambient condition. To achieve reliable defect characterisation, in situ measurements are preferred [2]. Here we present an approach how the irradiated specimens can be transported without breaking the vacuum using vacuum suitcase. This way, UHV-STM measurements at another nearby laboratory can be conducted.

[1] Madaus et al., Fabrication of nanoporous graphene/polymer composite membranes, Nanoscale 9 (2017) 10487

[2] F. Meinerzhagen et al., A new setup for the investigation of swift heavy ion induced particle emission and surface modifications, Rev. Sci. Instr. 87 (2016) 013903