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INTERACTIONS OF IONS WITH CARBON NANO-STRUCTURES

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Abstract. Investigation into the properties of carbon nano-structures, involving fullerene molecules, carbon nanotubes, and the most recently contrived graphene, has been growing at a relentless rate over the past decade or so owing to prospects of their applications in nanotechnology. While interactions with particle beams have been an important part of this research endeavor in the context of various spectroscopic techniques (TEM, EELS, ...), the use of energetic electron and ion beams has recently emerged as a novel engineering tool for modifications of atomic structure and electronic properties of carbon nano-structures (Krasheninnikov and Banhart 2007).

In that context, the most widely studied themes in literature are concerned with changes in carbon nanotubes upon exposure to the ion-beam irradiation at energies ranging from several tens of eV to some MeV. On the other hand, the empty cylindrical space in individual carbon nanotubes, and a high degree of their ordering and alignment in structures called ropes or bundles, provide unique means for achieving the effect of ion channeling. Prospects of realization and a range of possible applications of ion channeling through carbon nanotubes at energies from keV to TeV have stimulated an active research area, which was recently reviewed (Artru et al. 2005, Mišković 2007).

After assessing some key experimental facts and the status of computer simulations of ion irradiation effects on carbon nanotubes, I shall discuss several problems arising in modeling of ion interactions with carbon nanotubes (Mowbray et al. 2006) and with graphene (Radović et al. 2008) in the medium-to-low range of ion energies, where the dielectric response of those carbon nano-structures plays a significant role. Special attention will be payed to calculations of the stopping and image forces on ions due to plasmon excitations in carbon nanotubes and graphene, with an emphasis to scattering geometries of relevance to ion channeling.

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