Electron emission from coronene and fluorene molecules under fast ion impact: Collective excitation

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Synopsis Measurements of differential electron emission form PAH molecules under ion impact are reported. The forward backward asymmetry or the anisotropy parameter in e-emission spectrum from coronene reveals the plasmon excitation peak for coronene while for fluorine no such peak is observed. The energy and angular distribution of the absolute DDCS were compared with the CB1 model predictions

The study of ion interaction with polycyclic aromatic hydrocarbon (PAHs) molecules is important from astrophysical point of view. These molecules are continuously processed by cosmic rays and energetic photons in the interstellar medium (ISM), and their chemical and structural evolution influences different astrophysical processes like galaxy formation. Though there is large number of photon impact studies, the ion impact studies are very few in the literature. Moreover, within those most of these are fragmentation studies. Another aspect regarding these molecules is the possibility of having low energy collective electronic response like plasmon excitation. Because of having large delocalized π-electron cloud, the whole electron cloud may respond collectively to an external perturbation.

In the present study, we report the measurements of absolute double differential cross section (DDCS) of electron emission from coronene ($C_{24}H_{12}$) and fluorene ($C_{13}H_{10}$) molecules, which are two of the members of the PAH family, under the impact of 3.75 MeV/u O^{8+} ions. These measurements have been done for the ejected electron energy of 1 to 350 eV and in the angular range of 30° to 150°. In We have carried out quantum mechanical calculations based on first-order Born approximation with correct boundary conditions (CB1). The energy distributions of the DDCS show a monotonically falling behaviour with increasing electron energy which is quite similar to the observed behaviour for atom-ion collisions. The angular distribution of DDCS for coronene shows steeply falling trend with increasing angle in the low energy region, whereas for fluorine this is more isotropic in nature. The forward backward DDCS ratio, for coronene, reveals a peak exactly at the plasmon energy and is well reproduced by plasmon approximation model [1], whereas no such peak is observed for fluorine (See Fig. 1) [1]. The CB1 calculation in these cases, in general, provides a good qualitative description of the collision systems, though it does not include many body effect like plasmon excitation. It overestimates the experimental data by a factor of 2 - 3 [2].

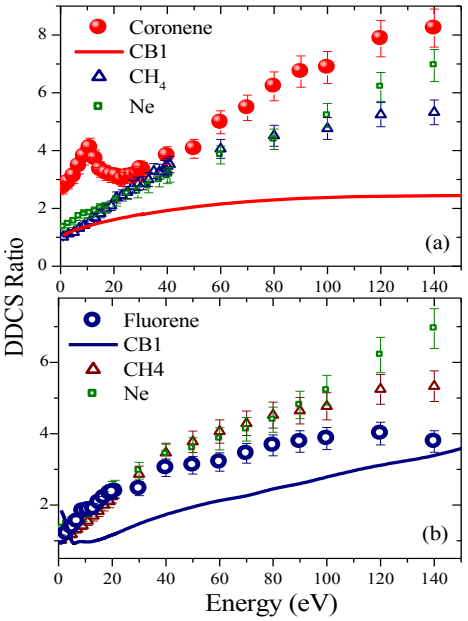

Figure 1. Forward-backward DDCS ratios for (a) coronene and (b) fluorene. The plots also include data for other targets (CH_4 and Ne) for comparison.

References

[1] S. Biswas and L. C. Tribedi, 2015, *Phys. Rev. A (Rapid Com.)* **92**, 060701

[2] S. Biswas et. al., 2017, (*under review: Nat. Sci. Rep.*)

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