Ionization of O_2 in collisions with 200 keV protons and 5.5 MeV/u bare C-ions

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Synopsis The experimental studies of electron emission from O_2 molecule ionized by 200 keV protons and 5.5 MeV/u energy bare C ions are presented here. The energy and angular distributions of the e-double differential cross sections (DDCSs) are compared with the state-of-the-art CDW-EIS calculations .

Oxygen, a homonuclear diatomic molecule has a reasonably large number of electrons. It's more complicated than simple atoms and molecules, such as, H, He or H_2. On the other hand its much smaller than the large bio-molecules, such as, nucleobases etc. Therefore for many purposes O_2 or N_2 can be considered as a bench mark molecule for a few-body system. The study of these molecules is important for testing the theoretical models for few body systems, apart from understanding the interference effect of multi-electronic diatomic molecules [1-4]. Very few experimental investigations on ionization of O_2 by proton and highly charged ions exist in the literature [3-6]. In this article, we will discuss about the ionization of oxygen molecules for different projectiles having different charge state and energy.

We report the measurement of the DDCS of the electrons emitted from O_2 when ionized by low and high energy ion beams obtained from two different accelerators at TIFR, Mumbai. Bare C ions of 66 MeV energy were obtained from the 14 MV Pelletron**.** The experimental chamber was flooded with the target gas at a constant pressure. A hemispherical electrostatic energy analyser followed by a channel electron multiplier (CEM) was used to measure the DDCS of the secondary electrons emitted from O_2. The DDCSs were measured for 12 different emission angles ranging between 20^0 and 160^0 [2]. Similar measurements were carried out with 200 keV proton beam, obtained from the 14 GHz ECR ion accelerator. In the present case, the target gas was introduced inside the scattering chamber with the help of an effusive jet source. The experiment was also performed in flooded chamber condion.

The present experimental study was performed at two different perturbation strengths to provide a stringent test to the theoretical models. For 66 MeV bare C ions, ionization is the most dominant feature with perturbation strength (q/v) of 0.403. On the other hand, for 200 keV protons, q/v = 0.35, for which capture and transfer ionization will also have significant contributions. The derived asymmetry parameter may provide crucial information on ionization dynamics.

The present work provides a comparison of the ionization cross sections of oxygen induced by keV and MeV energy projectiles, giving rise to different phenomena. The detailed results and comparison with state of the art theoretical CDW-EIS models will be presented.

References

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