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2 - 5 Charge State Effect on Si K X-ray Emission Induced by I^{q+} Ions Impacting

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The interaction mechanisms of highly charged ions and atoms have been extensively investigated and have the potential for surface characterization and material modification[1]. The charge state effect on K-shell ionization of Al target irradiated by Xe^{q+} ($q=12\sim29$) ions has been explained by using the molecular orbit transition mechanism in the velocity regime below the Bohr velocity[2]. However, near the Bohr velocity, there is a general lack of the charge state effect in the highly charged heavy ion-atom collisions.

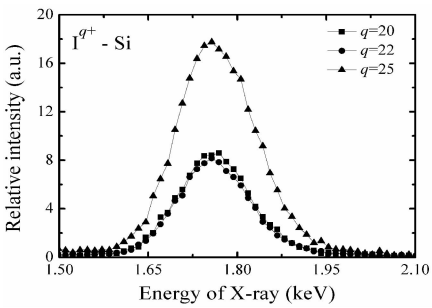

Fig. 1 The typical X-ray spectra induced by I^{q+} ($q=20$, 22, 25) ions.

In the present work, Si K X-ray emission spectra induced by I^{q+} ions were measured. The experiment was performed at the 320 kV ECR Platform for Highly Charged Ion Beam in Heavy Ion Research Facility in Lanzhou (HIRFL). The X-rays are detected with a Si Drift Detector (SDD), which has a detective area of 7 mm^2 in the front of the detector.

Fig. 1 represents the typical X-ray spectra induced by 3.0 MeV I^{q+} ($q=20$, 22, 25) ions impacting on Si target. It is found that, the only K X-ray of the target was observed, and the peak position did not change with the variation of the charge state of incident ions. In addition, it is obvious that the relative intensity of Si K X-ray induced by I^{25+} ions is larger than that by I^{20+} and I^{22+} ions. While for I^{20+} and I^{22+} impacting, the relative intensity of X-ray emission is almost equal.

In our experiment, comparing to I^{20+} and I^{22+} ions, the 3d vacancies of I^{25+} ions are more easily produced by quasi-molecular transition in the interaction of projectile ions and target atoms, since the 3d energy level of I^{25+} ions is more close to 1s energy level of Si atom[3]. In other words, the number of 3 d vacancies of I^{25+} ions is more than that of I^{20+} and I^{22+} ions during the interaction. Thus, the transfer probability of 3 d vacancies of projectile to the 1s orbital of target for I^{25+} ions is larger than that I^{20+} and I^{22+} ions basing on the molecular orbit (MO) model[4]. That transfer arises from rotational coupling of $3d\pi$, δ-$3d\sigma$ atom quasi-molecule. The increase of the transfer probability may make a considerable contribution to the enhancement of ionization of Si atoms induced by I^{25+} ions.

Further calculation on the phenomena will be carried out in the future.

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