EUV emission spectra of charge-selected Sn ions in charge exchange spectroscopy

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Charge Exchange Spectroscopy

Observation of EUV emission spectra from the individual charge states of Sn ions in charge transfer collisions of multiply charged Sn ions with neutral gas targets to provide spectroscopic data which are necessary for understanding of the high power EUV light source.

$$Sn^{q+} + Rg \rightarrow Sn^{(q-1)+*} + Rg^{+}$$

$$\downarrow \text{ photon emission}$$

$$Sn^{(q-1)+}$$

Rg : rare gas target = He and Xe

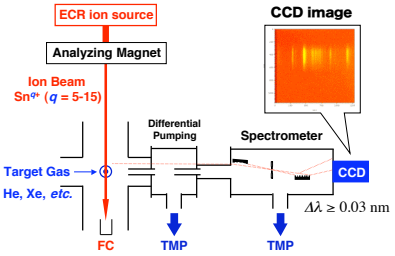
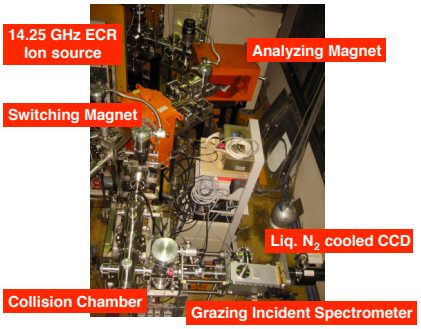


Fig. 1.Schematic diagram and photograph of the experimental setup in Tokyo Metropolitan University.



Experimental Results

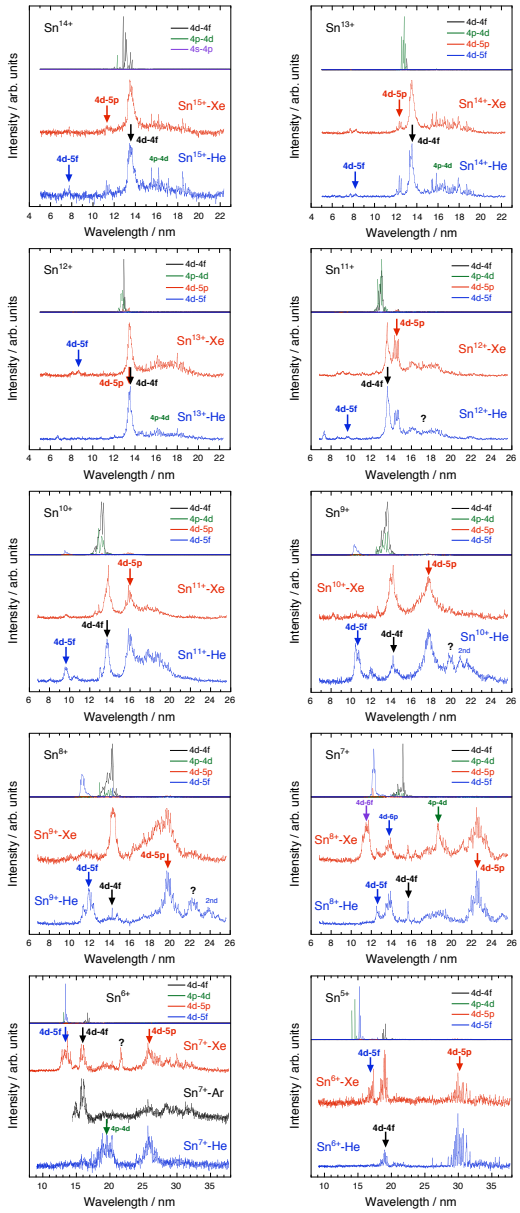


Fig. 2. Target dependence of EUV emission spectra in collisions of Sn^{q+} ($6 \le q \le 15$) ions with He and Xe at 20q keV. Relative transition probabilities of $Sn^{(q-1)+}$ ions calculated with the HULLAC code are also shown. Tentative identifications of transitions have been done by comparison with the theoretical results.

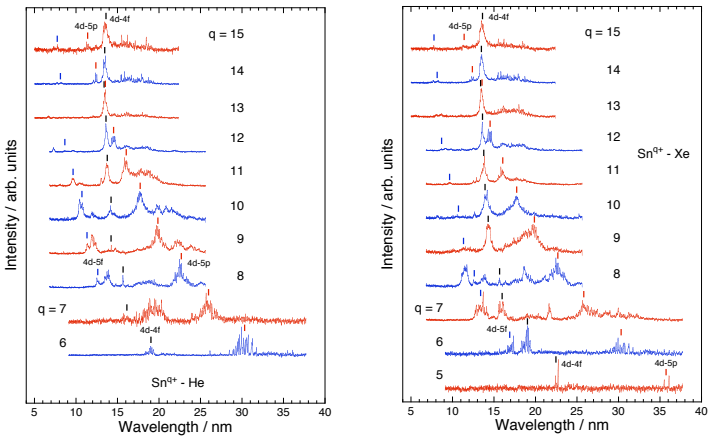


Fig. 3. Charge-state dependence of EUV emission spectra in collisions of Sn^{q+} ($5 \le q \le 15$) ions with He and Xe at 20q keV.

Discussion

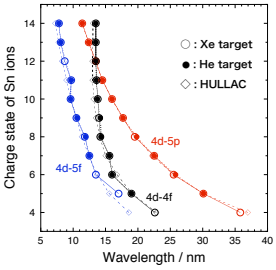


Fig. 4. Charge-state dependence of averaged transition wavelengths of Sn ions. Here we assume that the emissions are due to $Sn^{(q-1)+}$ ions produced by the single electron capture in collisions of Sn^{q+} with He and Xe.

- Differen target gas gives different population distribution in the excited states produced in the charge exchange reaction.
- However, the wavelengths of the peaks don't depend on the targets in this experiment.
- Prominent peaks in observed emission spectra have been identified by comparison with the theoretical results by using the HULLAC code.
- The averaged wavelengths of transitions shows good agreement between the experiments and the theoretical calculations for the 4d-5p and 4d-5f transitions.
- Oh the other hand, the 4d-4f transitions have approximately constant differences about 0.5 nm between the experiment and the calculation as in results for Xe ions.

Comparison with sparks

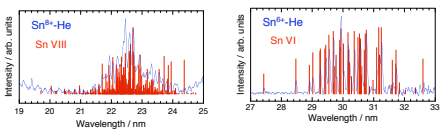


Fig. 5. EUV emission spectra from vacuum sparks and those in this work.

References

Sn VIII :
V. I. Azarov and Y. N. Joshi, J. Phys. B 26 (1993) 3495.

Sn VI :
Y. N. Joshi and Th. A. M. van Kleef, Can. J. Phys. 55 (1977) 714.

- Emission spectra from vacuum sparks show qualitatively good agreements with those in the charge exchange spectroscopy.
- This finding indicates that the charge exchange spectroscopy is very useful technique to analyze radiation from plasmas.
- The reason of this agreement must be investigated much further.

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