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Charge state distribution of ions resulting from the decay of the 2p→3d photoexcited states of atomic Fe

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1. Introduction

The photoprocess of the 3d metal atoms is of basic and practical importance. About two decades before, some of us had investigated a series of photoabsorption spectra in the 2p→3d excitation region of the 3d atoms Sc, Cr, Mn, Fe and Cu using the total photoion-yield technique [1]. From the viewpoint of atomic and plasma physics, it is very important to study the decay process of the 2p→3d excitation states. As a part of such studies, we have measured charge state distribution of final photoions for Fe atom.

2. Experimental

A monochromatized synchrotron radiation from beamline BL-7A was crossed with an atomic beam from a metallic oven of electron bombardment type. The photoions resulting from the photon-atom interaction were, with the aid of periodic positive pulses, pushed into the time-of-flight (TOF) tube and were detected by a detection system consisting of a microchannel plate (MCP) and subsequent electronics in counting mode [2]. After measurement of total photoion-yield spectrum, the TOF spectra were measured at selected photon energies.

3. Results and Discussion

Figure 1 shows the total photoion-yield spectrum of isolated Fe atom (bottom), which is almost the same as the absorption spectrum, and the charge-state distribution at selected energies (top). We can see some tendencies from these figures. First, the formation of Fe^{+} ions at the excitation peaks B, C and E are quiet weak in comparison with those at off-peak energies. Second, the largest component in the charge state distribution changes from Fe^{2+} below the lowest excitation peak B to Fe^{4+} above the first 2p ionization limit (around 720 eV), and the average charge increases on the whole against the photon energy correspondingly. These experimental results are in course of analysis, including calculations of the excitation energies and oscillator strengths using the GRASP92 atomic code.

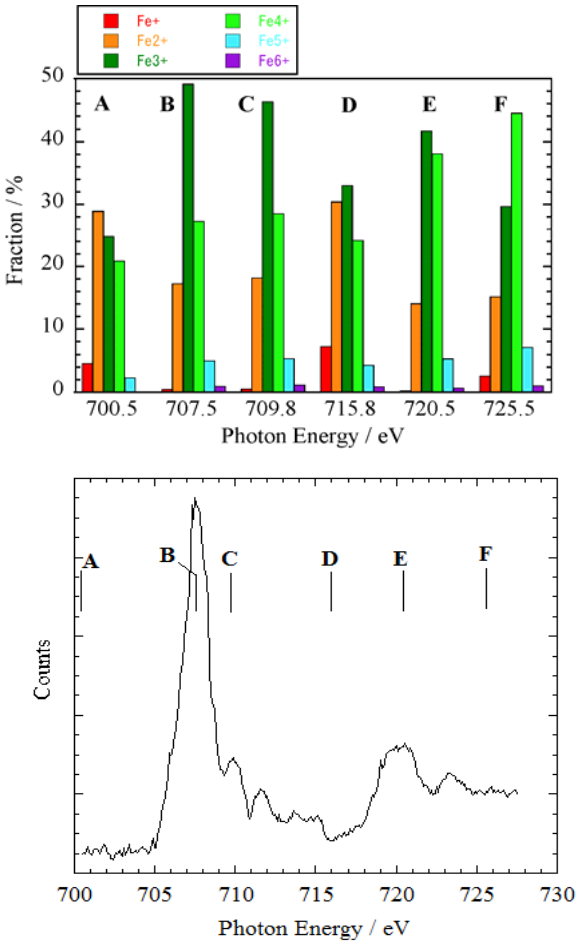

Figure 1. Top: Charge-state distribution at selected (A, B, ···) photon energies. Bottom: Total photoion-yield spectrum in the 2p→3d excitation region.

References

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[2] Sato *et al* J. Phys. B: At. Mol. Phys. **18** (1985) 225.