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Progress of Z-dependence analysis of soft X-ray spectra from highly charged heavy ions using high-temperature plasmas

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Soft X-ray emission spectra from highly charged heavy ions are of particular interest in nuclear fusion research, industrial light source applications as well as basic atomic physics. Though a number of experimental spectra have been recorded so far in tokamaks and electron beam ion traps (EBITs), the available data are still insufficient to complete the atomic number (Z) dependencies for the elements in the 5th and higher periods. In the last decade, therefore, we have systematically recorded soft X-ray spectra from highly charged ions of various heavy elements using high-temperature plasmas produced in the Large Helical Device (LHD) at the National Institute for Fusion Science.

In this paper we present recent progress of Z-dependence analysis for the soft X-ray spectra from highly charged ions of the elements with Z from 57 to 74, based on the experimental data taken in the LHD. In particular, we focus on the isolated lines of Cu-, Zn-, Ga-like ions which have relatively simple spectral features. The measured wavelengths are compared with the other data taken in tokamaks and EBITs, as well as theoretical values calculated with a multi-configuration Dirac-Fock code. In addition, the Z dependencies are interpolated or extrapolated to assign unidentified lines. As a result, a number of lines have been experimentally identified for the first time. Some of the results clearly manifest large effects of configuration interaction and spin-orbit interaction, which are peculiar to highly charged heavy ions.

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