Observation and Identification of Tungsten Spectra Observed with an Electron Beam Ion Trap

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Tungsten will be used as a plasma-facing material in ITER, and thus is considered to be the main impurity ions in the ITER plasma [1]. In order to suppress the radiation loss due to the emission from the impurity tungsten ions, it is important to understand the influx and the charge evolution of tungsten ions in the plasma through spectroscopic diagnostics. Thus, atomic data needs for tungsten ions have been noted in recent years, and a lot of experimental and theoretical effort has been made so far. However, further efforts are still strongly needed as the required data spread over wide ranges of charge state and wavelength.

An electron beam ion trap (EBIT) [2] is one of the powerful experimental devices for the spectroscopic studies of highly charged ions. An EBIT produces highly charged ions through successive ionization of trapped ions by a quasi-monoenergetic electron beam. The produced ions, which are mostly in the ground state, can be trapped with a narrow charge state distribution for many hours. It thus provides simple spectra that are useful to identify previously unreported lines [3].

The identification procedure often involves two steps. The first step is to identify the charge state of the ion that should be assigned to each line, and the second is to identify the upper and lower levels of the transitions. The first step can be done without the help of theory. For example, the electron beam energy dependence of the spectra is often used for identifying the charge state based on the fact that the maximum charge state in the trap is determined by the electron energy [3]. On the other hand, the second step needs theoretical support. In order to analyze EBIT spectra, collisional radiative model calculations are needed [4]. In both steps, careful analysis is needed especially for relatively low charge states, e.g. many electron systems, for which the energy level structure becomes complicated. In this paper, we present our recent efforts to observe and identify the relatively low charge state of tungsten ions with a compact EBIT [5].

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