Theoretical approach to determine the high-temperature tokamak plasma parameters

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We propose a theoretical advanced approach to determine the parameters for plasma generated in tokamaks. It is based on a detailed interpretation of the high-resolution X-ray spectra structure for tungsten from Zn-like to Co-like and molybdenum Ne-like ions that can, and have, be registered by the KX1 crystal spectrometer on the JET tokamak with an ITER-like wall. An earlier paper found that high-resolution M X-ray spectra structures of tungsten ions can be properly interpreted only by including separately all the individual contributions from the $4s^1$, $4p^1$, $4d^1$ and $4f^1$ subshell states for the 4d→3p transitions in the case of Cu-like (W^{45+}) ions, and also separately both 4s→3p and 4d→3p transitions for the Co-like (W^{47+}) ions. Here a similarly detailed analysis is done for the M X-ray line structures coming from Cu-like and Co-like tungsten ions and L X-ray line from Ne-like molybdenum ions in different high-temperature plasmas. The predictions are obtained within the Collisional-Radiative approach by the Flexible Atomic Code package, for plasma electron temperatures from 2.0 keV to 6.0 keV and a single electron density, 3×10^{19} m^{-3}, that is relevant to JET. The obtained shapes of spectra for Cu- and Co-like tungsten and Ne-like molybdenum ions (benchmarks) are important part of prepared reference base, which is crucial for applications of proposed approach. These results should be also useful for ITER, and for tokamaks such as WEST and ASDEX Upgrade, where tungsten plasma-facing components are implemented and kept track of with a high-resolution X-ray diagnostic similar to those based on the KX1 spectrometer.