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Atomic data calculations for electric dipole transitions in doubly-, trebly- and quadruply-charged rhenium ions (Re III–V) of interest to nuclear fusion research

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It is now well established that tungsten will be one of the main divertor components of the ITER nuclear fusion reactor. When D-T fusion takes place, very energetic neutrons will strike the walls of the reactor and cause the transmutation of tungsten atoms by irradiation. The primary transmutation products for tungsten are rhenium, osmium and tantalum. In particular, the calculations revealed that, after 5-year irradiation under first wall fusion power-plant conditions in ITER, Re, Os and Ta would reach concentrations of 3.8, 1.4, and 0.8 atomic percentage, respectively. As with tungsten, during fusion operations, these atoms, and more particularly rhenium atoms, will be torn from the reactor wall and enter the plasma where they will constitute impurities contributing to the energy loss by radiation but can also be used for plasma temperature and density diagnostics from the analysis of their spectra in all ionization stages. Therefore the radiative properties of these ions have potential important applications in this field. The purpose of the present work is to provide a new set of atomic data (oscillator strengths and transition probabilities) for electric dipole lines in rhenium ions, from Re III to Re V, obtained using two independent theoretical approaches, i.e. the pseudo-relativistic Hartree-Fock (HFR) and the fully relativistic Dirac-Hartree-Fock (MCDHF) methods.

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