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Electron Scattering from Neutral Tin Atoms and Doubly-Charged Tin Ions

Synopsis
A cross section dataset has been calculated for electron scattering from the ground and first four excited states of neutral tin using the Relativistic Convergent Close-Coupling method. Integrated cross sections have been produced over a projectile energy range of 0.1 eV to 1000 eV for all major processes. Maxwellian rate coefficients with analytical fits are available for electron temperatures ranging from 0.5 eV to 200 eV. Electron collisions with Sn+2 have also been studied and cross sections have been produced for various excitations, total-inelastic scattering and total-single ionisation.

With recent developments in the fields of fusion research and nano-lithography, collision datasets for tin are becoming increasingly important. Plasma-facing components in tokamak fusion reactors such as ITER experience large amounts of erosion due to bombardment from the plasma [1]. This damage from erosion is especially an issue for the divertor region of such fusion reactors [2]. To combat this, liquid metal designs for the divertor are currently in development for the European DEMO reactor which promises major improvements over the current tungsten mono-block design adopted in ITER. The primary candidate material for this new design is tin. Extreme-ultraviolet (EUV) lithog- raphy is an advanced microchip manufacturing technique which uses a tin plasma to generate the 13.5 nm light [3]. However, the details on how this light is produced in the plasma are not well understood. Ongoing research in both fusion and EUV requires reliable electron collision datasets for tin and its ions.
The Relativistic Convergent Close-Coupling method (RCCC) [4] has been applied to calculate integrated cross sections for elastic scattering, various excitations, total scattering (TCS), total-inelastic scattering (inel-TCS), and single-ionisation of the ground and first four excited states of neutral tin. State-resolved cross sections have been produced for excitations to all states in the the *5p2*, *5p6s*, *5p5d* and *5p6p* manifolds. Previous studies for tin have not been as extensive and used first-order approximations which are accurate only at high projectile energies. This is the first study in which accurate results have been produced for all transitions studied over the entire projectile energy range from 0.1 eV to 1000 eV. Rate coefficients with analytical fits to a simple formula have been included for use in modelling applications. The RCCC approach has been also used to calculate cross sections for many important excitations from the ground state of Sn+2, for which there is no previous data.

References
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