Absolute Cross Section for Electron Impact Excitation of Ground State Si^{2+}

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Electron-impact excitation (EIE) is the dominant mechanism for the formation of emission lines in many astrophysical plasmas. Absolute line intensities and their ratios to one another can provide diagnostics of the temperature and density of the emitting plasma, and of the abundances of the elements within the plasma. Modern space observatories such as the Hubble Space Telescope, the SOHO solar mission, and the upcoming AXAF mission measure UV and X-ray line intensities with detectors calibrated to a high degree of accuracy, placing more demand than ever on the atomic physics community to provide accurate atomic data. Theoretical calculations can provide the vast numbers of atomic rates used for the interpretation of emission line measurements, but experimental benchmark measurements are required to test the accuracy of the calculation methods.

At the CfA Ion Beam Facility we are continuing an ongoing program to measure absolute cross sections for EIE and dielectronic recombination. We have recently completed a measurement of the absolute cross section for EIE of $Si^{2+}(3s^2\ ^1S - 3s3p\ ^1P)$ for energies below threshold to 11 eV above. A beams modulation technique with inclined electron and ion beams was used, where the radiation from the excited ions at $\lambda120.6$ nm was detected using an absolutely calibrated optical system. The population of the $Si^{2+}(3s3p\ ^3P^o)$ metastable state in the incident ion beam was determined to be $22.4 \pm 2.5\%$. The data have been corrected for contributions to the signal from excitation of the metastable state, and for higher energies, from excitation of the ground state to levels above the $3s3p\ ^1P$ level. The experimental 0.5 ± 0.05 eV energy spread allowed us to resolve complex resonance structure throughout the studied energy range. At the reported 15% uncertainty level (90% confidence limit), the measured structure and absolute scale of the cross section are in good agreement with 12-state close-coupling R-matrix calculations[1][2].

References:

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