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Electron-Impact Excitation of Complex Atoms: Impact on Gaseous Electronics Applications[1]

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In recent years there have been a number of experimental and theoretical investigations of electron-impact excitation (EIE) cross sections with improved measurement techniques and state-of-the-art calculations. These investigations not only reveal many interesting aspects of basic physics of electron collision with neutral atoms, but they are extremely important for many gaseous electronics applications such as lighting, plasma processing, and gas lasers. We will present the current status of many theoretical calculations of EIE cross sections using distorted-wave (DW) and close-coupling R-matrix and B-spline R-matrix methods for several noble gases such as Ar, Kr, and Xe in particular and compare them with recent improved measurements by the University of Wisconsin group using a Fourier-transform spectrometer. Although in some cases there is qualitative agreement between theoretical and experimental results, even with the advancements of both theoretical and experimental techniques and improved data, quantitative discrepancies still exist in most cases. We will present some of the issues regarding the disagreement and also discuss the significant effects of EIE data for various applications. In particular, results from this study have been used to model an electron beam pumped Ar-Xe laser at NRL. We will also comment on the complexity involved in calculating the structure and EIE cross sections of a complex open-shell element such as Mo and its implications for modeling a molybdenum discharge lamp.

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