Data Evaluation for Atomic, Molecular and Plasma-Material Interaction Processes in Fusion

The electron scattering data base - Is it fit for purpose ?

N J Mason

The Open University, Walton Hall, Milton Keynes, MK7 6AA United Kingdom

n.j.mason@open.ac.uk

Electron induced reactions in both the gaseous and condensed phases initiate and drive many of the basic physical and chemical processes in science and technology with applications from industrial plasmas to radiation damage in living tissue. For example, in contrast to previous hypotheses, collisions of very low energy secondary electrons with the components of DNA molecules (or to the water around them) has been shown to be a crucial process in inducing radiation damage in the DNA of living systems. Understanding electron interactions with larger biomolecules is therefore providing new insights to radiation damage and thence the development of new, alternative radiotherapies. In the technological field electron induced reactions underpin most of the multibillion dollar modern semiconductor industry since it is those reactive fragments produced by electron impact of etchant gases that react directly with the silicon substrate. Studies on electron scattering from molecules capable of improving the etch rate of surfaces are leading to development of new (environmentally cleaner) plasma technologies. Electron induced processes are also of extraordinary importance for determination of structure and chemical reactivity of species adsorbed on surfaces.

Such research and technology is intricately linked to our knowledge of the key interactions between electosn and atoms and molecules and thus we require a database for characterizing electron interactions with atomic and molecular species. However the compilation of the electron collsion data required is rarely a coherent, planned research programme instead it is a parasitic process. Indeed today it is rare for researchers to be funded to measure fundamental collision processes since these are no longer regarded in themselves as ‘cutting edge’ research rather the field has developed to explore more exotic phenomena such as cold atoms; nanotechnology and chemical control.

The fundamental research community, the providers of such data, therefore need to assemble, update and police a set of approved databases. This is no longer as complicated as it was a decade ago. Most publications are accessible online and most authors place their data on home pages and in archives, Hence compiling databases is easier than it was in the past for example by using the General Internet Search Engine for Atomic Data (GENIE) developed as part of the International Atomic Energy Agency facility. In this talk I will review the current status of the electron scattering databases, how they are assembled and updated and thus whether they are ‘fit for purpose’ or if not how they may be developed to meet the challenges of the 21st century Science and technology. I will contend that ultitalte it is or the communityu to develop a method for archiving and recommending sets of electron scatterign data and propose methods by which this can and will be done.

Finally it should be noted that the greatest challenge to the community is to maintain the infrastructure (including people) that will allow the fundamental data to be collected. This in turn challenges the wider scientific community to recognize that their fields rely upon such data. A united applied and fundamental research community must then confront the funders of research (government and industrial) to ensure that such data compilation, evaluation and curation must be supported and sustained.