X-Ray Absorption Spectroscopy in the Study of Ion Mobility

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X-Ray Absorption Spectroscopy (XAS) is a technique that allows the study of the structure of condensed matter, liquids, amorphous and crystalline solids. The technique is usually considered in terms of two variations. Firstly, Extended X-ray Absorption Fine Structure (EXAFS) which provides information on the local structure around a target atom to a distance of $\approx$ 5 Å; radial distance of neighbours, number and types of neighbour. Secondly, X-ray Absorption Near Edge Structure (XANES) which allows determination of the oxidation state of a target atom. XAS experiments are now undertaken predominantly on specialized beam lines at synchrotron sources. This contribution will begin with a brief review of XAS procedures, including access to instrumentation, sample requirements and novel technique developments.

XAS by itself provides only structural information, however when it is used in combination with other techniques, such as NMR, electrochemical methods or computer modelling, it is powerful in determining diffusion pathways and dynamics. This will be illustrated by case studies of examples taken from materials used in energy generation and storage, *i.e.*, batteries, fuel cells and photovoltaics. The group at Kent leads a consortium using XAS to study energy materials and some of this work will be used as examples. This will include studies of nanomaterials, cathodes for lithium-ion batteries and catalysts for water electrolysis.