Guest Editorial
The Materials Science of Fuel Cells

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It is my pleasure to introduce this special section of the *Journal of Materials Science* entitled "The Materials Science of Fuel Cells". Whilst fuel cells are not necessarily new technology – the concept was identified in the mid 19th century – there has been a phenomenal growth in the development of this technology over the past 30–40 years as the need to provide alternative power sources was identified. It is the commercial interest in fuel cell technology that has promoted the intense activity in this field and it is only now that this research effort is being translated in to commercially viable fuel cell devices.

The aim of this section is to introduce the reader to that area of research loosely termed fuel cells. Obviously the scope of the section is limited and there cannot be an exhaustive study of the many different fuel cell types and associated research. However it is hoped that by drawing on the experience of many established figures in the fuel cell community the reader will be introduced to fuel cells and inspired to pursue an interest in this rapidly developing area.

As an introduction to the section Professor Brian Steele has contributed an extensive review of the types of fuel cell device currently under development and identifies the difficulties associated with each device. Consideration is given to the materials selection criteria for each type of device and the engineering issues are summarised. Furthermore, the choice of fuel, the infrastructure and energy storage issues are also discussed.

The remainder of the section is composed of a combination of brief reviews and original research papers covering all aspects of fuel cell development. Much of the research effort directed towards fuel cells can be categorised as anode, cathode or electrolyte related and each of these areas is covered by the authors contributing to this section. The development of new electrolyte materials is discussed in contributions from Ishihara *et al.* and Huang *et al.* and it is evident from these that the selection of electrolyte materials for use in fuel cells is still the subject of considerable debate.

This is also true of the cathode materials. Hart *et al.* describe a functionally graded cathode which alleviates many of the materials selection difficulties in developing, in particular, solid oxide fuel cells. Whilst many of the authors deal with the materials selection criteria Selcuk *et al.* report on their work on the influence that electrodes have on the strength of fuel cell devices. This highlights the diversity of issues surrounding the manufacture of commercial devices.

The growing importance of computer modelling in the prediction of behaviour of fuel cell materials is represented by the contribution of Mari *et al.* This paper also introduces the reader to the concept of ionic conductor composites for use as electrolyte materials, combining the high ionic conductivity of one ceramic material with the high strength of a second.

Having presented a brief overview of the contents of this special section I trust that readers will find the contents as stimulating and interesting as I have. Although by no means exhaustive this section provides an excellent introduction to the rapidly developing field of fuel cells.

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Dr Stephen Skinner joined Imperial College as a postdoctoral research associate in 1998 and was appointed as a lecturer in October 1999. His research interests centre on the properties and structures of ion conducting oxides, with emphasis on *in situ* high temperature studies using x-ray diffraction and Mössbauer spectroscopy. In particular this work is pursued with the development of new materials for fuel cells and ion conducting membrane technologies in mind.

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