



Prof. Robin Grimes

The Future of Nuclear Fuels and Materials through Atomic Scale Modelling

Abstract

Materials in reactor systems are subject to damage to a greater degree than in any other industrial components. While a consequence of radiation effects, damage is also a result of thermal, chemical and mechanical processes. No wonder it is so difficult to predict the evolution of a material's response or even identify the atomic scale processes through which properties change. For example, in fuel atomic displacements are coupled with astounding temperature gradients and half the periodic table is introduced as a consequence of the fission process. Compositions may also change in fusion components leading to complex phase stability challenges. Thermal conductivity is a central concern for the design engineer but predictions demand that we understand an array of scattering terms, which depend on composition and temperature. Transport processes mediate the evolution of property and composition change but defects can both facilitate migration mechanisms and trap species: this includes fission gas, the release of which controls fuel residence lifetime.

Here specific challenges to experimental and modelling activities are presented as examples of the overall need to advance our basic understanding. This is necessary to both develop new systems and extend the use of current materials. Examples will focus on the author's recent research on metallic systems for fusion and fuels for fission.

Biography

Robin Grimes is the UK Foreign & Commonwealth Office Chief Scientific Adviser and the Ministry of Defense Nuclear Chief Scientific Advisor. He is also Professor of Materials Physics at Imperial College and was previously Director of the Imperial College Centre for Nuclear Engineering and the Rolls Royce University Technology Centre in Nuclear Engineering. His primary research interest is the application and development of computer simulation techniques to predict structural and dynamic properties of inorganic materials for energy applications. He is a Fellow of the Royal Academy of Engineering.