Developing shielding materials for fusion

PhD scholarship

Recent development in *spherical tokamaks*, have shown that smaller magnetically-confined fusion reactors are a promising avenue for rapid development and commercialization of fusion energy. However, a significant barrier to the success of spherical tokamaks, is the limited space available for shielding of sensitive components, such as superconducting magnets, from the high energy radiation produced inside the plasma (Figure 1). Conventional shielding material (lead, steel, concrete) provide inadequate shielding, leading to excessive heating and radiation damage of the superconducting coils, which in turns reduces component lifetime, plasma efficiency, and increases maintenance costs.

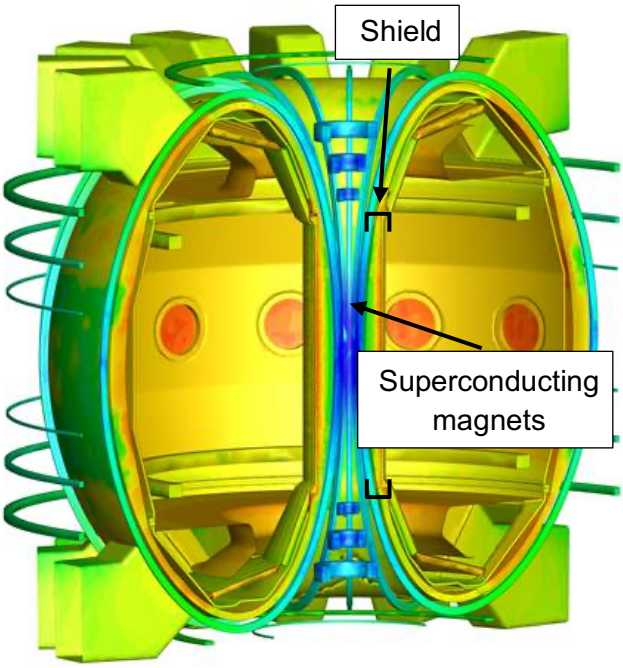

Figure 1 – Tokamak fusion reactor. Blue areas are at –250 °C, red areas reach over 100 million °C. The shielding must protect central column from heat and radiation generated inside the chamber.

Recently, new candidate tungsten boride ceramics and ceramic-metal composites have been identified as potential advanced shielding materials. While these materials have exceptional thermo-mechanical properties, their response to the extreme environment of a fusion reactor is yet unknown. The aim of this project is to develop an understanding of the radiation damage in these advanced shielding materials when exposed to fusion radiation, and the effect that these will have on the materials properties.

The project is part of a partnership between UNSW Sydney, and the UK company Tokamak Energy. The candidate will be based in the AtomCraft research group led by Dr. Patrick Burr and will collaborate with Dr Edward Obbard and Dr Kevin Laws. The candidate will perform atomic scale simulations, both classical and quantum-mechanical, to study the production and evolution of defects, and to help develop mitigation strategies to inform alloy design of radiation-tolerant shielding materials. A background in materials science or materials engineering or physics is beneficial, as is competence in computer programing.

This position comes with a high remuneration package, with a bursary of up to $48,000/yr plus up to $10,000 in travel and equipment support. The student will work in a tight-knit, inclusive, and enthusiastic group of diverse background. We value diversity and encourage applications from all backgrounds to apply. The project will allow ample opportunity for domestic and international collaboration, especially with (but not limited to) Imperial College London (UK), Tokamak Energy (UK), and the Australian Nuclear Science and Technology Organization (ANSTO).

Send email applications and queries to e.obbard@unsw.edu.au and p.burr@unsw.edu.au. When applying, please include your CV and transcript of most recent or current degree (or interim transcript if degree is not yet completed).