Title of studentship	The Physics and Mechanics of Creep Cavity Nucleation and Sintering in Energy Materials
Location	School of Physics, University of Bristol, UK
Funding for (UK/EU/o'seas)	Eligibility includes, but is not limited to, being a UK or EU national who was resident in the UK for three years prior to the start of the project.
Funding amount	Funding will cover UK/EU tuition fees, maintenance at the UKRI Doctoral Stipend rate (£15,009 per annum, 2019/20 rate) and a training support fee of £1,000 per annum for a period up to 3.5 years.
Hours	Full time
Contract (temp/perm)	Temporary

The project:

Introduction and Background

Creep strength enhanced ferritic (CSEF) steels are a group of steels which offer the potential for excellent physical and mechanical properties. Grade 91 and Grade 92 CSEF steels are now routinely used for high temperature components in advanced power generating plants. In-service Life Management approaches for CSEF steels must offer cost effective guidance for reducing the risks of failure. This project complements existing knowledge produced at EPRI; the knowledge created will have industrial impact through improved design methods as well as lifetime assessment procedures and societal benefits through improved assurance of fail-safe operation of power plant. Such improvements offer the potential for extending the life of plant, with the attendant benefits to minimising impact on climate change. The models produced will provide a comprehensive understanding of the factors affecting the formation and growth of creep cavities. Damage of this type is at the heart of low ductility failure of high temperature components. Thus, the research outcomes from this latest research will underpin significant improvements which will minimise creep failure in service. This knowledge is one of the inputs linked to improvements in damage tolerance of CSEF steel components.

Collaboration

The research in this project will link with a collaborative initiative supported by the UK Engineering and Physical Sciences Research Council (EP/R026076/1; Bristol PI = Professor Peter EJ Flewitt, FREng). The overall research initiative will consider the physics and mechanics of creep cavity nucleation and sintering that occurs in polycrystalline materials. The materials selected will have different compositions and microstructures. There are three universities participating in the overall programme - Open, Oxford and Bristol. The research described here will be carried out through a PhD studentship funded by the Electrical Power Research Institute (EPRI), Palo Alto, USA at the University of Bristol.

The researcher will thus be based within the Interface Analysis Centre, School of Physics, University of Bristol. S/he will also work closely with the Department of Engineering Science, University of Oxford (Professor A Cocks). In addition, there will be close collaboration with EPRI. EPRI will provide a series of laboratory- and service-exposed creep specimens on tempered martensitic steels of known pedigree.

Objectives

1. Provide quantitative descriptions of how thermal history (including peak temperature, holding times and cooling rates) defines details of the microstructure developed and define the link between microstructural features and creep damage susceptibility.
2. Detail the microstructure pre-cursors to cavity formation and the factors influencing nucleation, growth and link up of cavities. Based on information from Objective 1 seek to define thermal treatments to reduce the susceptibility for cavity formation in components.
3. Provide understanding of the inter-relationship between microstructure, stress state and damage

which lead to new material models. These robust and validated models will be directly relevant to the development, application and advancement of life evaluation procedures adopted for 9Cr1Mo steel, and related electrical power plant components. Such improvements also offer the potential to minimise impact on climate change by removing the need for immediate rebuild.

How to apply:
Please make an online application for this project at http://www.bris.ac.uk/pg-howtoapply. Please select Physics PhD on the Programme Choice page. You will be prompted to enter details of this specific project in the 'Research Details' section of the form.

Candidate requirements:
A first degree in physics, materials science, materials engineering or a related subject, normally at a level equivalent to at least UK upper second-class honours, or a relevant postgraduate master's qualification. Ideally a combined interest in experimental and modelling approach.
For international equivalent qualifications see http://www.bristol.ac.uk/international/study/countries/ on the International Office website.
Language requirements http://www.bristol.ac.uk/study/postgraduate/2019/sci/phd-physics/ also apply.

Funding:
Stipend: Electric Power Research Institute (USA).
Fees: Electric Power Research Institute (USA).
Travel/consumables: Electric Power Research Institute (USA).
Funding length: 3.5 years.

Contacts:
For informal enquiries about the project contact peter.flewitt@bristol.ac.uk or tomas.martin@bristol.ac.uk.
For enquiries about the application process contact physics-pg@bristol.ac.uk.