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Amorphous carbon and variant vacuum thin film coating systems for PWR tribological applications EngD

(Protective diamond-like tribological coatings for the inside of nuclear reactors)



Jack Cooper (mtp11jc@sheffield.ac.uk), Allan Matthews, Adrian Leyland



The Project

This engineering doctorate project aims to characterise the performance of several commercial diamond-like carbon coatings for use in the pressurised water reactor environment.

The fundamental knowledge and understanding from this research will then be used to produce an optimised coating system for Rolls-Royce civil and defence PWR operations.

The Research

Pressurised water reactors often use protective coatings to improve the tribological contacts between engineering components whilst protecting the underlying materials.

There is presently a drive to reduce the usage of cobalt containing hard facing coating materials like Stellites as their activation produces the synthetic radioisotope Co-60, which is responsible for a considerable amount of the radioactivity hazardous to plant workers.

There also exists a pressure to increase the durability of plant components in an effort to extend operating lifetimes and performance, as well as allowing the emergency core cooling system to maintain control during any loss of coolant incidents within the reactor.

Amorphous diamond-like carbon has been suggested as an alternative as its possible attractive properties include high hardness, chemical inertness and low friction. This project will analyse the mechanical and chemical performance under typical PWR conditions in order to develop the detailed understanding necessary to produce an optimised coating system.



The Industrial Influence

The benefits to pressurised water reactors in the civil and defence industry include:

Reduction in Reactor Maintenance

Improved Reactor Safety

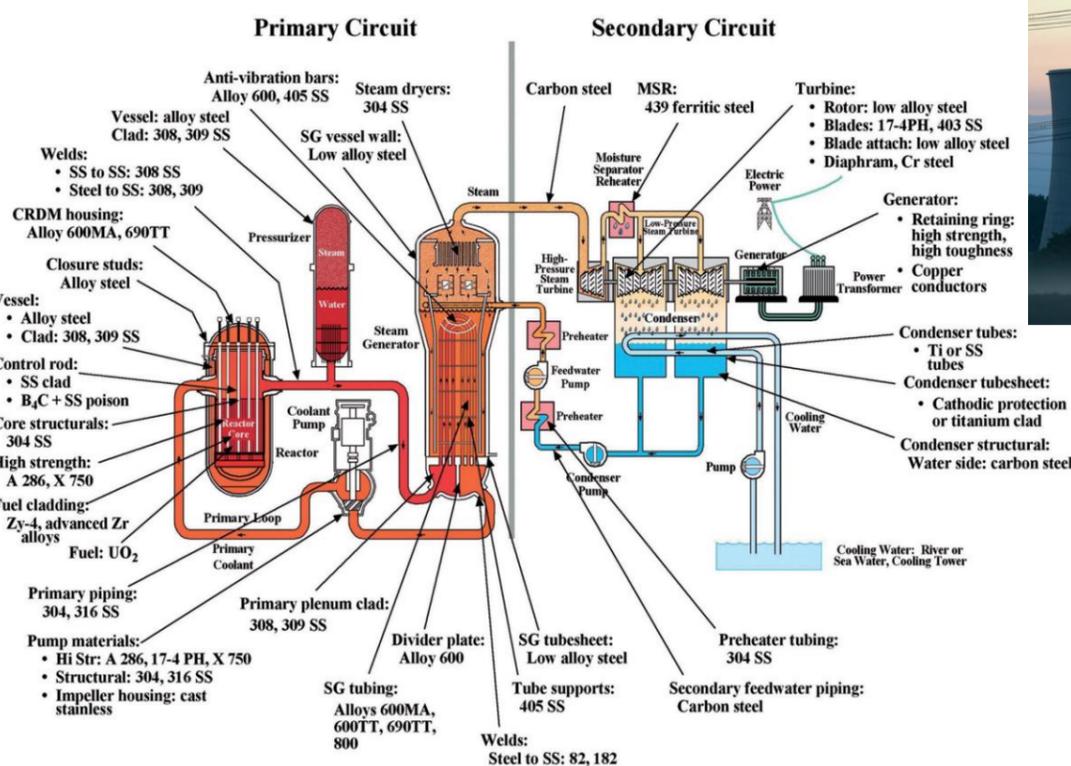
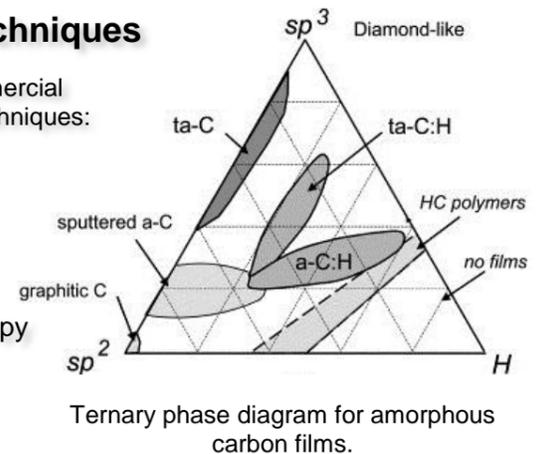
Extended Reactor Lifetimes

Lower Costs from Reactor Downtimes

The Characterisation Techniques

The characterisation of current commercial coatings will include the following techniques:

- ◇ Profilometry
- ◇ Indentation techniques
- ◇ Wear Testing
- ◇ Scanning Electron Microscopy
- ◇ Optical Microscopy
- ◇ X-ray Photoelectron Spectroscopy
- ◇ Visible & Ultraviolet Raman Spectroscopy
- ◇ Autoclave & Salt Spray Corrosion Tests



Typical application of pressurised water reactor materials.