

From Atoms to Alloy Engineering Behaviour

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ABSTRACT In this talk, I will examine two main topics, the behaviour of titanium alloys in gas turbines and the development of new Co/Ni superalloys. Titanium alloys, whilst generally possessing very good specific fatigue strengths, do suffer from some cracking modes which are occasionally of concern to gas turbine manufacturers. Hot Salt Stress Corrosion Cracking is one issue that we have recently been concerned with, which leads to hydrogen embrittlement at the crack tip. We will examine some post mortem analysis of a real crack, in an attempt to shed light on the cracking mechanism. This will lead us into a discussion of LCF cracking in vacuum and in air, and the examination of the behaviour of subsurface cracks using X-ray tomography. It will also lead us to dwell fatigue, and I will present recent work on α_2 precipitation, which is strongly implicated in dwell. Turning then to Co/Ni alloys, the recent discovery of the L12 coherent $\text{Co}_3(\text{Al,W})$ precipitate has excited much interest in the development of a new class of Co superalloys. I will outline the development philosophy underlying our recent patents on this subject, discuss the current status of this work and the challenges still to be overcome, and the underlying scientific issues to be explored.



David Dye is a professor in the Department of Materials at Imperial, which he joined in 2003 from the National Research Council in Chalk River, Canada. His undergraduate degree and PhD were from Cambridge University, on the weldability of nickel-base superalloys. His postdoc work in Chalk River concerned the development of neutron diffraction measurements in micromechanics, in situ welding and single crystal superalloys. He has also worked at a number of nuclear sites, beginning at Berkeley labs in the UK. At Imperial, he has been a hall Warden, Senior Tutor and teaches phase diagrams, stress tensors and alloying. He has graduated 16 Phd students and is widely cited for his work of titanium and nickel alloys. In 2010 David was awarded the IOM3 Harvey Flower Titanium Prize.