



Sustainability in Materials Science

Prof. Rob Wallach

Short Course: 27 Nov 2011, Americana Condesa Cancun All Inclusive Resort, Cancun, Mexico

Sustainable development is essential if the earth is not to be damaged irreversibly. While this includes many aspects such as education, population control, combating disease and providing adequate food and water health care, this course focuses on the key role of Materials Science in addressing energy considerations and contributing to solutions for improved energy provision for combating global warming.

The major part of the course deals with renewable energy sources (solar power, geothermal, wind, and wave), as well as nuclear power, and conventional power. It also includes overviews of energy storage and the hydrogen economy. For each topic, the background to, underlying scientific principles as well as materials' considerations are covered. The course concludes with a brief overview of how materials science already contributes to many different and more diverse sustainability topics.

At the end of the course, participants should have an increased awareness of the different approaches, and the role of materials science in their optimisation, which can provide solutions to future energy needs without compromising further global warming.

Who Should Attend

This course will be beneficial to those who wish to gain a better understanding of the choices that are arising in providing energy and the various materials issues that are or will need to be addressed. Hence this course will be of interest to those in industry, the public sector or academia who have to take a broader look at the implications of, and challenges in, future energy provision, undergraduate and graduate students are strongly colvied to attend.

Course Outline

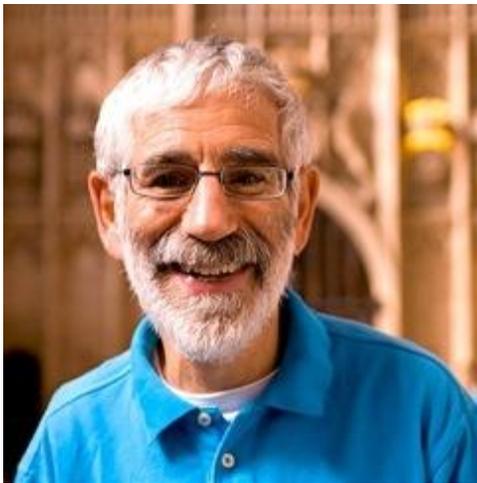
- **Introduction.** Sustainability issues and the rôle of Materials Science.
- **Forms of energy.** Renewable and non-renewable energy sources, energy usage.
- **Solar energy.** Greenhouse effect and rates of decay. Solar energy conversion: direct (including solar cells) and indirect (including biomass)
- **Wind power.** Wind turbine operation, designs and mechanisms. Power available and maximum power extraction. Rotor efficiency and design. Materials used for rotors.



- **Water.** Power available from dams and rivers, reaction and impulse turbines, power outputs, turbine selection. Wave energy: power dependence, wave power devices. Tidal flow and barrages. Materials for dams: concrete.
- **Geothermal.** Earth's core and temperature profile. Geothermal reservoirs. Geothermal power plants, direct heating and heat pumps. Geothermal energy: heat flow model, heat extraction and aquifer lifetimes. Geothermal power potential.
- **Conventional power generation.** Fossil-fuelled power generation. Engine efficiencies. Gas emissions and cleaning. Fossil power plant and gas turbine material challenges.
- **Steels and high-temperature materials.** Review of steels and transformations. Properties required in energy systems. Stainless steels. Creep resistant steels. Oxide dispersion strengthened alloys. Other materials: summary of aluminium, titanium, copper-based and nickel alloys.

The participants will also receive:

- ◆ CD with course material
- ◆ Certificate of completion
- ◆ Lunch and refreshments



Course Instructor Prof. Rob Wallach

Rob Wallach is a Senior Lecturer in the Department of Materials Science & Metallurgy in the University of Cambridge. His undergraduate degree was from Cambridge, after which he carried out industrial research for four years with Alcan International in Canada while also completing a part-time MA. He returned to Cambridge to do a PhD and subsequently was appointed to the faculty there.

Rob's research is centred on the joining of materials, both understanding the basic science and also in optimising approaches for new materials; potential applications currently include aircraft engine turbine blades, car bodies,

and electronic components. Industrial collaboration has been considerable and much appreciated.

In recent years, Rob has become increasingly involved in and responsible for a wide range of University activities, primarily those focussing on education and welfare issues for current and potential students (including setting up and running diverse outreach courses). He teaches extensively and has been awarded several teaching prizes. Rob enjoys tennis and music – at suitably low levels!

REGISTRATION: <https://www.flogen.com/FraySymposium/registration.php>

