HEmS grant Early Career Researcher group meeting

PRACTICAL ASPECTS OF HYDROGEN CHARGING

Depts. of Materials and Engineering Science, University of Oxford – 17 April 2015

The Early Career Researchers group of the 'HEmS – Hydrogen in Metals' grant met in Oxford to discuss various aspects of working within a large EPSRC Programme Grant team.

The day centred on presentations from the Atom Probe group (ATP) at Oxford's Materials Dept., looking at the challenges, and dangers, of working with hydrogen. Dr Daniel Haley and PhD student Yi-Sheng Chen from the ATP group at Oxford presented on the methods and equipment they are designing around the process of 'charging' hydrogen for their advanced characterisation experiments looking at hydrogen embrittlement. The morning concluded with a tour of their labs and the gas and liquid charging cells they are developing. The research forms part of Work Package 2 in the HEmS grant.

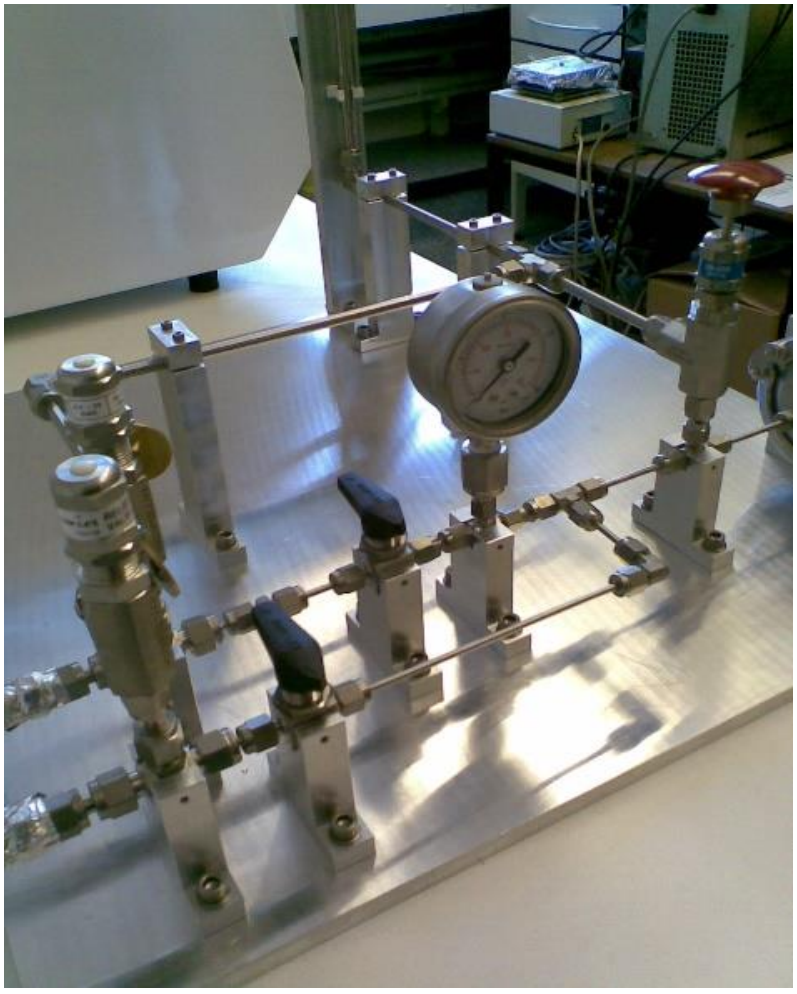
The HEmS Early Career Research group at the hydrogen charging meeting

Background to the ATP work in HEmS:

We are investigating the behaviour of hydrogen at the atom-level, to better understand what causes hydrogen embrittlement, a phenomenon where materials will suddenly fail early in their lifetime when near sources of hydrogen, such as water. This is not simply inconvenient, but can be hazardous to the safe operation of critical equipment. Currently there is only limited understanding of exactly what causes hydrogen embrittlement, as it is tricky to be able to see the small hydrogen atom when it is embedded in a material.

To investigate this, we use a microscopic technique, known as "Atom Probe Tomography" (APT) to be able to build a 3D image of the atoms within the material - including hydrogen. Atom probe creates images of the material around 100x50x50 nm in size, and can tell us which atoms are located at which position in the material.

As hydrogen is so small and fast-moving, we have developed two ways of getting the hydrogen to stay in the material long enough for us to be able to observe it. Our first method uses a pressurised chamber to force hydrogen into our sample. Our second method uses a liquid electrolyte, in which we immerse the sample, and apply a voltage to force hydrogen from the liquid into the material. Once done, we quickly insert the sample into the atom probe to analyse it.



In-situ gas charging cell designed by the Atom Probe group at Oxford

By imaging the hydrogen and material together, we can see how new materials respond to this introduced hydrogen, and thus design embrittlement resistant materials. The atom probe component of the HEMs project aims to develop hydrogen imaging in APT to a straightforward method for imaging hydrogen in steels (and other materials), to better understand the ubiquitous role of hydrogen in toughness reduction.

HEmS – Hydrogen in Metals

HEmS (Hydrogen in metals - from fundamentals to the design of new steels) is a major initiative to investigate the process of embrittlement of metals from hydrogen. The research is funded by the EPSRC and is a joint collaboration between the Universities of Oxford, Cambridge, Sheffield and Imperial and King's Colleges London. http://www.hems.ox.ac.uk/