



NMI3 Sample Environment JRA

High Pressure task: Why and what?

08.10.2009

Why?

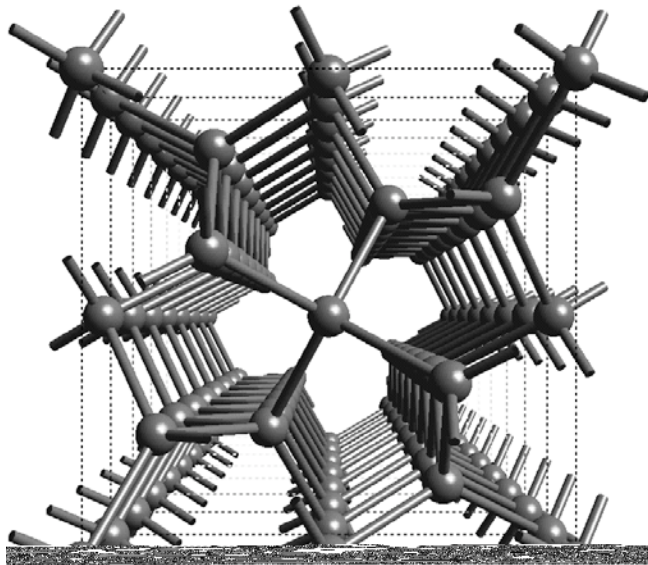
- Neutron scattering studies at high pressure quite often require fairly large sample volumes.
- In this case the high pressure technique based on a gas medium compression proved to be very effective.
- The pressure medium is contained in a vessel whose wall thickness is a function of both the mechanical strength of the material and the internal dimensions (size of a sample).
- The vessel wall material should have high mechanical strength as well as acceptable neutron absorption and scattering properties.



Currently this technique covers the pressure range up to $\sim 0.7\text{GPa}$ (7 kbar).

Why?

The *high pressure gas vessels* are intensively used in neutron scattering experiments in a number of scientific areas (few examples):



The oxygen framework of the twelfth phase of crystalline ice structure viewed down the *c*-axis.

- *Clathrate hydrates*
Phys. Rev. Lett. **93**, 125503 (2004)
- *Large isotropic negative thermal expansion*
Nature **396**, 147 (1998)
Phys. Rev. Lett. **86**, 4692 (2001)
- *High-pressure water ices*
Nature **391**, 268 (1998)
Phys. Rev. Lett. **93**, 225901 (2004)
- *Iron arsenides superconductors at high pressure*
Phys. Rev. B **79**, 024513 (2009)
- *Metal – insulator transition in perovskites*
Phys. Rev. B **52**, 9248 (1995)
Phys. Rev. B **56**, 8265 (1997)



What?

Inert Gas Cells

Tasks:

1. *High pressure gas vessel technology report*
2. *13 - 15 kbar 'oil' intensifier for hydraulic testing*
3. *10 kbar automated gas handling system for inert gases*
4. *Design and produce cells and test seal systems up to 8 kbar (LT – 300 K)*
5. *Design and prototype 10 kbar cells for 300 K*



What?

Hydrogen Cells

Tasks:

1. *Report on material research (H_2 compatibility and neutron transmission properties)*
2. *Sourcing and assembly of 8 - 10 kbar H_2 intensifier and gas handling system*
3. *Produce and test cell for 4 kbar and up to 700 K*
4. *Produce and test cell for 6 kbar and up to 300 K*
5. *Design and prototype 8 kbar cells for LT – 300 K*

High pressure task - ISIS

Inert gas cells:

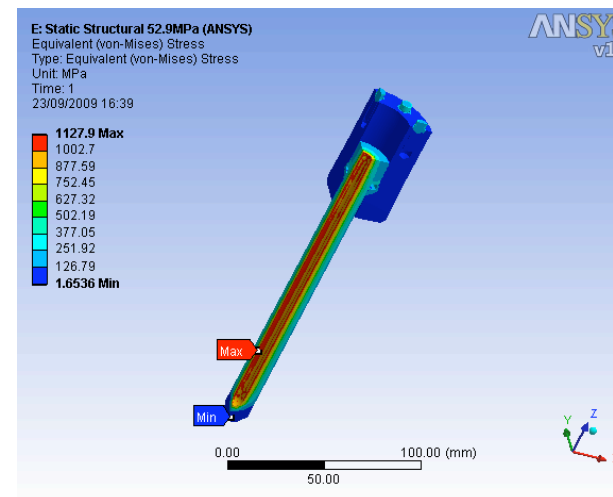
- Report on current technology: draft complete.
- 10 kbar intensifier: specifications complete; intensifier now in manufacture.
- Hydraulic intensifier: 13-15 kbar upgrade work scheduled.

Hydrogen cells:

- Material research and report: collaborative project with Imperial College underway.
- 10 kbar H₂ intensifier: specifications complete and in tender process.
- 4 kbar cell: design stage complete.
- HZB 10 kbar system: visited January 09



Hydraulic intensifier



4 kbar cell: FEA