**Pressure Induced Complexity in the Elements**

Malcolm McMahon, *School of Physics and Centre for Science at Extreme Conditions, The University of Edinburgh, Edinburgh EH9 3JZ, U.K.* . E-mail: mim@ph.ed.ac.uk

At ambient pressure, the metallic elements typically adopt high-symmetry crystal structures such as bcc, fcc and hcp. However, on compression, many of these simple structures undergo a series of structural transitions to phases characterised by considerable structural complexity, and it is only with recent advances in high-pressure single-crystal and powder-diffraction techniques that many of them have been determined. In the group 1, 2, and 15 elements, we have found a number of incommensurate “hotel” structures comprising interpenetrating host and guest structures [1]; transitions between these composite structures [2]; modulations of the host and guest structures; a transition to a composite structure with a "liquid" guest component [3]; and a number of surprisingly complex commensurate structures. And in the group 16 elements, we have found a number of incommensurately modulated structures that are stable over a remarkably wide range of pressures and temperatures [4]. I will review all the recent results on these "simple" metals, and discuss possible explanations for the existence of this complexity.

[1] McMahon M. I., Degtyareva O., Nelmes R. J., *Phys. Rev. Lett.,* 2003, **85**, 4896. [2] Nelmes R. J., Allan D. R., McMahon M. I., Belmonte S. A., *Phys. Rev. Lett.,* 1999, **83**, 4081. [3] McMahon M. I., Nelmes R. J., *Phys. Rev. Lett,.* 2004, **93**, 055501. [4] Hejny C., McMahon M. I., *Phys. Rev. Lett.,* 2003**, 91**, 215502.

**Keywords: incommensurate phases, high pressure physics, metals**