Working Group I: Summary Report of Subgroup on Condensed Matter/Materials Science & Technology

S. K. Sinha, G. Materlik

The group first discussed the question of damage by making simple back-of-the-envelope estimates of the number of atoms ionized in one pulse. The conclusion was that a sample subjected to a $100\mu \times 100\mu$ beam could sustain acceptable damage (~1 atom in 10^4 per second for a hydrocarbon sample), but a focused ($1\mu \times 1\mu$) beam of this intensity would be catastrophic for the sample, and the information would have to be obtained in a single pulse.

The main scientific opportunities seen by the group lay in pump/probe type measurements, which exploit the pulsed nature of the source, and in studies of dynamics. For pump/probe type studies, some of the conceivable studies were: (a) the use of megagauss pulsed magnetic fields to study the chemical and magnetic structure of materials under intense magnetic fields; (b) the employment of both Bragg and diffuse x-ray scattering to study the mechanism of deformation during the passage of shock waves through the materials; (c) the study of domain wall motion by magnetic domain imaging in pulsed field conditions; (d) imaging of three-dimensional grain boundaries and crack propagation in solids; (e) the structural response of materials in the pico/femto second time scale to intense laser pulses; and (f) magnetic fluorescence holography.

Dynamical studies envisioned included: (a) the study of the kinetics of first order phase transitions (domain movement or reorientation, etc.); (b) photon intensity correlation studies utilizing multiple pulses and the full transverse coherence, particularly in connection with q-dependent dynamics of polymer chains, proteins, etc.; (c) Compton scattering with 0.01 a.u. resolution; (d) study of dynamics of valence fluctuations; (e) the use of the XFEL for carrying out conventional inelastic x-ray scattering, where the XFEL brilliance can result in increased intensity but only if a monochromator with

$$\left(\frac{\Delta d}{d}\right) \lesssim 10^{-8}$$

can be found, or for other special cases such as very small samples (e.g. samples under high pressure), etc.

(Attendees for this group included: G. Materlik, S. K. Sinha, S. Mochrie, J. Hastings, I. Lindau, C. Fadley, P. Montano and K. Fezaa).