Contribution ID: **324** Type: **Oral Presentation**

PLENARY: Optical Techniques Applied to Materials Physics

Tuesday, 30 June 2015 09:00 (1 hour)

Abstract content
   (Max 300 words)
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Brillouin and Raman light scattering techniques provide powerful methods to study the properties of materials. In general, laser light interacts with the vibrating atoms of the material and a tiny fraction of the scattered light emerging from the sample is changed in frequency.
Brillouin scattering concerns the coupled movement of the unit cells constituting bulk and surface waves in the GHz region. From such studies, the elastic stiffnesses of materials are established that determine the resistance of the material to deformation and depend on variables such as temperature and pressure, microstructure, composition and strain. A (3+3) pass tandem Fabry-Pérot interferometer system and a frequency-stabilised laser are used to resolve the very small changes in frequency.
Surface Brillouin scattering studies of the elastic properties of near opaque bulk solids and thin supported films at both ambient and high temperatures are discussed. Determinations of the elastic stiffnesses of bulk materials such as platinum group alloys and iron pyrite, and thin supported films of tungsten carbide are described.
Raman scattering refers to the atoms within the unit cells or within molecules moving with respect to one another and is used to identify the nature of a material, its state of crystalline perfection, changes of phase, the presence of inclusions, and the effects of temperature, pressure and strain. A grating spectrograph is employed to resolve the spectral features and is fitted with a Raman microscope enabling 2-and 3-dimensional mapping. Low and high temperature stages and high-pressure cells are available.
Raman scattering studies include radiation-induced defects in alkali halides, recrystallisation of ion beam induced amorphised layers, stress mapping in single crystal and polycrystalline diamond, the temperature dependence of the vibrational modes of single-walled carbon nanotubes, and the passivation and pitting of iron during corrosion processes.

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Session Classification: Plenary

Track Classification: Track H - Plenaries