THERMOLUMINESCENCE AND ITS APPLICATIONS IN THE STUDY OF CONDENSED MATTER

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Thermoluminescence (TL) is the thermally stimulated emission of light after a solid insulating sample is subjected to ionizing radiations or other forms of excitation such as optical or even to mechanical pressure. TL emission is observed in the form of glow peaks. The number of glow peaks emitted from a given sample represent the number of defect centre types. The phenomenon of TL provides a unique tool for the study of a large area of low concentration defect centres. The technique can be used at 7 to 10 orders of magnitude lower defect concentrations in comparison to optical absorption. The photonically induced re-distribution of charge carriers in a sample pre-irradiated by ionizing radiations provides a very sensitive way to correlate certain glow peaks with the colour centre type defects. One can for example observe F-F' and M-M' conversions by tunneling effect.There are a variety of other radiation effects in solids which too are related to lattice defects. These include electrical conductivity and exo-electron emission. The correlative studies of these different thermally stimulated phenomena provide important information about the defect centre structures. This paper gives a critical overview of the subject including the aspects which remain to be further investigated.

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Hyperfine Interactions and Angular Distribution of Nuclear γ-rays: Applications in Solid States Physics.

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Until recently, the whole subject of angular distribution or correlation of γ-rays was from the experimetal point of view mainly of interest to nuclear physicists, where it provided a valuable tool for the determination of some important properties of nuclear states such as spin, magnetic moment, and quadrupole moment under special circunstances. However it is realized that the study of the perturbation of the angular correlation is of great interest in its own right and provides important method for measuring hyperfine interactions in solids and liquids.

Both methods, perturbed angular correlation (PAC) utilizing radioactive probe and perturbed angular distribution (PAD) following nuclear reactions measure hyperfine interaction parameters and allow to study the electronic (charge) and magnetic (spin) structure of materials. Like Nuclear Magnetic Resonance (NNR) and Mossbauer Spectroscopy (MS) they yield insight into materials of interest and the electromagnetic fields therein on a rather local and microscopic scale. As nuclear techniques both, PAC and PAD take the advantage of high sensivity in detecting nuclear radiation allowing investigations with negligible probe atom concentrations e.g. extremely dilute alloys.

The techniques have been used extensively to study the origin of electric and magnetic hyperfine fields at dilute impurities in (metallic) hosts. They have also been used to study a variety of other phenomena such as radiation dammage, point defectes in metals and semiconductors and more recently high temperature superconductors and related oxides.

A brief introduction to the underlying principles and experimental techniques in PAC and PAD will be outlined. Some special features of PAD studies following the heavy reactions will be descried. A brief discussion of the parameters which can be extracted from the experiment will be presented. Some examples will illustrate the recent developments in the field of magnetism including measurements of hyperfine fields at impurities in 3d and rare-earth ferromagnetic hosts and other magnetic systems like Heusler alloys. Role of impurity valence on the electric field gradients (EFG) in non-cubic metallic systems will also be discussed. Some examples of the study of point defects in metals and alloys using perturbed γ-γ angular correlation will be presented.