

REVIEWS OF BOOKS

Synchrotron Radiation: Selected Experiments in Condensed Matter Physics

W. Czaja (Ed.), Birkhäuser Verlag, Basel 1991

The reviewed book *Synchrotron Radiation: Selected Experiments in Condensed Matter Physics*, edited by W. Czaja, contains invited talks and two contribution presentations from the workshop held in July 1990 at Monte Verità, Ascona in Switzerland. The lectures presented at the workshop included a tutorial, introductory part and a presentation of new trends and new experimental methods available in the fields under consideration. This book can be therefore recommended to a wide community of condensed matter physicists who search for new techniques hoping to find the answer to their unresolved problems. Wider experience in the field of X-ray physics or synchrotron radiation is not necessary to read this book but in order to acquire new methods it is desired to read also most of the cited papers. The tutorial part of each paper provides brief summary of what has been done up to the present using conventional X-ray or other techniques and, next, new phenomena or new techniques elaborated on the basis of unique properties of synchrotron radiation are presented. This kind of presentation provides an excellent background for the understanding of new phenomena and an argument as to their potential future developments. The list of related references allows the reader a quick selection of most of the important papers, and lets him justify which of the new phenomena have already been experimentally and theoretically confirmed, and can subsequently be used as new tools in physics. The only disadvantage of the book is the lack of uniform presentation of references and especially in the paper by Schutz; the presentation of references is rather unusual and difficult to follow. The choice of themes covers most of the newly developed, important and promising fields where the use of synchrotron radiation leads to progress in solid state physics.

The first section, "Magnetic Properties", contains a few papers concerning the application of synchrotron radiation to study the magnetic properties of bulk materials, surfaces and interfaces. Altarelli and Cairra presented elemental consideration of the X-ray absorption and scattering processes by an electronic system. The interaction of photon with electron spin was predicted by theory and observed in conventional experiments many years ago, but until the application of the synchrotron radiation the experiments were so arduous that these phenomena could not be exploited as a tool to study magnetic properties of matter. In the next two chapters written by Schütz and by Sirotti and co-workers a reader can find a brief review of experimental setups used in magnetic experiments as well as some results of investigations performed so far. A very interesting observation of magnetic dichroism on holmium overlayer on non-magnetic silicon (111) crystal is presented by Sakho and co-workers in the last chapter of this section.

The second section, "Electronic Structure", presents the collection of new experimental methods of investigation of the electronic structure of materials. These methods, e.g. resonant photoemission or determination of band structure by normal electron emis-

sion, are feasible, since the tunable light from synchrotron source is available. The results of investigations of band structure in semimagnetic semiconductors using these new methods are reviewed in the paper by Middelmann and Gumlich. How to distinguish between different clusters of Pt deposited on SiO_2 substratum and when the metallic band is already formed we can learn from a very stimulating paper by Fayet and co-workers. The unique study of electronic structure of liquid metals and alloys is discussed in the paper by Indlekofer and Oelhafen. The crystal field multiplet approach to the theory of X-ray absorption by de Groot showed how much the new experimental achievement stimulated theoreticians to look for a new solution of old problems. Stuck and co-workers presented an additional advantage of X-ray photoelectron diffraction, the possibility to distinguish between contributions to the photoelectron valence band for different components of alloys and chemical compounds.

In the third section, "Interfaces", written by Cimino, the very burning problem of capability of photoelectron spectroscopy to study the Schottky barrier formation is discussed in detail. The occurrence of surface photovoltage effects during the photoemission process is considered, as well as a comparison between several theories and experimental results is given. These previously neglected surface photovoltage phenomena affected some of the earlier published photoemission data concerning the band bending and Schottky barrier determination. A very important conclusion results from these considerations — most evaluations of Schottky barrier performed by photoemission need new experimental confirmations!

The use of synchrotron radiation for determining of crystal structure has a rich tradition and wide bibliography, therefore a reader can easily find several review papers on these subjects. The section "Crystal Structure" in the reviewed book contains therefore only one, but excellent paper written by Weber. This paper presents general considerations illustrated by carefully chosen examples, emphasizing the advantages brought by the high brightness, small vertical divergence and easy tunability of synchrotron radiation.

The section "Outlook" contains characteristics and description of some possible experiments with a third generation storage ring "Elettra" which is under construction near Trieste in Italy. Most of the examples for scientific experiments are obtained by extrapolation of what can already be done with the present synchrotron radiation source, taking into account the high brilliance of a new generation machine. This section contains then also an overview of possible application of synchrotron radiation in almost all experimental disciplines from physics to medicine and from chemistry to biology. But as we can learn from history and as is stressed by Rosei, the most fascinating applications of third generation synchrotron radiation sources are far from being foreseeable.

The presented book is an excellent example of progress which has been achieved during the last few years in experimental science by exploitation of a new kind of light source. Light in all the history of human civilization was the most important source of knowledge about nature and still continues to reveal new fascinating phenomena.

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