High- T_c Superconductors and Related Materials

Material Science, Fundamental Properties, and Some Future
Electronic Applications

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High- T_c Superconductors and Related Materials

Material Science, Fundamental Properties, and Some Future Electronic Applications

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FOREWORD AND PREFACE

In these Proceedings selected problems of high-temperature superconductors and related compounds are reviewed, which range from fundamental questions of basic research till future electronic applications. At first glance it seems to be an unrealistic aim for a single school since it covers a quite broad field. On the other hand there is an increasing number of fundamental properties of these compounds which are relevant to future applications, opening new possibilities. Some of them, such as the high transition temperature and the upper critical field, are apparently helpful, whereas other properties, such as the short anisotropic coherence length and the d -wave symmetry of the superconducting order parameter, which affect the possible critical currents, yield strong restrictions for potential applications.

It is noteworthy that the achieved high technological level in producing thin films and nanostructures allows to perform sophisticated experiments intended to study in detail such phenomena as subgap-plasmonic excitations, which have never been performed or even been considered theoretically. Last but not least several conceptions and ideas created in the field of classical superconductivity, such as the spatial structure of the superconducting order parameter in the vicinity of interfaces and/or twinning planes, have a significant impact on other condensed matter problems such as wetting phenomena, and this impact is reciprocal.

In general, the following issues frequently considered during the whole ASI might be pointed out: (i) Fermi liquid properties and determination of the Fermi surface, (ii) different vortex states in superconductors and related phenomena, (iii) fluctuations of the superconducting order parameter, (iv) order parameter symmetry and anisotropy in relation to the underlying pairing mechanism and general consequences for experimentally accessible properties, (v) the influence of real structure effects such as grain boundaries, nonlocality effects and various kinds of local disorder. For more detailed information on the considered scientific topics the reader is referred to the Content part.

In our opinion young people should be involved as much as possible in learning and eventually developing coherent views on these broad areas. In this context we consider the stimulating atmosphere of an ASI, having a long tradition in supporting science and in particular the physics of superconductivity and the materials science of superconductors, ideally appropriate to achieve this purpose. In the course of the ASI in addition to the main lectures, most of them presented in this book, several miniworkshops available upon request and devoted to plasmon excitations, borocarbides, problems of Ginzburg-Landau theory, and the Bernoulli effect in superconductors were organized for the young scientists.

We would like to note that several lecturers, working hard on their manuscripts, tried to update their lectures to provide the reader with comprehensive and tutorial introductory reviews of their topics. In our opinion those valuable contributions compensate the retardation we had in the editing the manuscript of the present Proceedings. We are indebted to KLUWER Publishing Company and especially to Annelies Kersbergen for their patience and support.

The nice Bulgarian Black Sea coast is a traditional scientific meeting point, in particular for scientists coming from Western and Eastern Europe. It is noteworthy to remember that organizing an ASI gives also some support to young scientists from Eastern European and other NATO cooperative partner countries, which is difficult to overestimate in the present complicated transition period for science in that region. Therefore, the large percentage of participants from those countries can be regarded as a success for Albena ASI. Furthermore we are glad to mention that several of our ASI-students I. Askerzade, A. Kordyuk, A. Mikitin, E. Ozkan, E. Penev, D. Nikolova, A. Posazhennikova, N. Zahariev, and others succeeded in the meantime to establish a collaboration with ASI lecturers.

The welfare of an ASI depends not only on the purely scientific aspects but also very much on the venue and its meeting facilities. Thus the Albena resort, which has good conference centers, accommodation, meeting facilities and sport centers, has been selected. The Cultural Center in Albena where the ASI took place, from 13 to 26 September 1998, with its neighbouring hotels, offered excellent conditions for the participants. Situated only 3 min. from the Sea coast, we succeeded to minimize not only the costs (in the after-season) but also any perturbation from tourist activities. Thus not only during the lecture sessions but also during the free time intensive scientific discussions could take place among the participants. Especially for the young scientists the discussions with the lecturers were a unique experience and gave them together with the oral presentations and posters (some of them included in the present book too) the opportunity to present and critically discuss their projects and create new common proposals.

This ASI was made possible due to the generous support by the NATO Scientific and Environmental Affairs Division, Brussels, Belgium. The directors wish also to express their gratitude for additional support by the Institute of Solid State and Materials Research Dresden (IFW-Dresden) and the University of Sofia. We are grateful to the conference secretary, Valya Mishonova, for her exquisite organization and continuous kind attention towards the participants of the NATO-ASI and for preparing and producing the booklet. We are deeply indebted to Joseph Indekeu for his indispensable help in the finishing of these proceedings enhancing the cooperation between us and the last delayed lecturers. Andrea Runow and Peter Joehnk (IFW Dresden) are acknowledged for their assistance in coordinating invaluable financial and technical support for the ASI.

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S.-L. Drechsler

T. Mishonov

Co-Directors of the ASI