Preface

The last years have seen rapidly growing interest in the explanation and interpretation of mesoscale microstructures occurring in distorted crystalline objects as, for instance, plastically deformed metals and alloys, high – performance materials as ultra – fine grained polycrystals, nanocrystals, or thin films. In many cases the microstructure formation of such materials is characterised by collective dislocation behaviour triggering off the formation of rotational microstructure elements as e.g. dislocation walls and subboundaries, misorientation bands, cell blocks or fragments, respectively, or shear bands. This raises, for example, questions as: How are rotational microstructure elements formed and how do they evolve on the mesoscopic scale? How do such substructure elements interact with individual dislocations and/or with internal boundaries, and how do they influence the macroscopically observed mechanical properties as e.g. the flow stress or the fracture characteristics of crystalline materials ?

In order to find answers to these questions, besides the traditional dislocation theory the concept of disclinations can advantageously be used. Volterra introduced disclinations into the theory of elasticity as the rotational counterparts of the (translational) dislocations already in 1907, but it was more than fifty years later when scientists started, at first in the USA and then mainly in Russia, to develop the theory of disclinations in crystals on the base of the concept of self – screening configurations of partial disclinations represented e.g. by non – compensated nodes of a cell – block structure or by terminated dislocation walls in the substructure of strongly deformed metallic materials.

Unfortunately, up to now the interrelations between dislocations and partial disclinations and the important potential of the disclination theory for the explanation of mesoscale microstructures of distorted crystals are not generally known. For this reason, in order to bring together researchers working experimentally with distorted crystalline materials and scientists concerned with the theoretical treatment and the interpretation of local lattice rotations by means of both dislocation and disclination theory, the International Workshop "*Local Lattice Rotations and Disclinations in Microstructures of Distorted Crystalline Materials*" was held at Rauschenbach/Erzgebirge (Germany) in April 2000. This issue of Solid State Phenomena presents most of the papers presented at the workshop, giving insight into the actual state of the field. In this connection it may be rendered, that for the first time the disclinations were the main subject of an international meeting. The editors hope that the publication stimulates scientists working in solid state physics and materials science to take into account this theory as an efficient tool of microstructure modelling, analysis, and interpretation.

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