© by Oldenbourg Wissenschaftsverlag, München

# PREFACE

The registration of the results of scientific work is of utmost importance, not only to produce a fair chronicle of the historic development, but above all to facilitate communication between contemporaries. The printing of scientific works and especially the electronic publication of the present day have been the cardinal instruments to continuously accelerate the speed of scientific progress (seen as an average over centuries; long periods of stagnation occur at irregular spaced moments of time in every field of science). Exchange of knowledge and ideas is even more essential in a scientific field of strongly multidisciplinary nature. Therefore, the publication of the **Proceedings of Size-Strain V**, the fifth representative of a conference series specifically devoted to the "Diffraction Analysis of the Microstructure of Materials", is imperative. In view of the above remarks, this is done as a "hard copy" but, in particular, at the same time in electronic form in "open access" format, on the world wide web, as a Supplement (No. 27, 2008) of the Zeitschrift für Kristallographie.

The behaviour of solid materials depends, in the language of today, largely on the arrangement of the constituent atoms in the solid. We have learned that many crucial properties of materials cannot be understood on the basis of the idealized ordering of the atoms as could be indicated for crystalline solids. The deviations in the atomic arrangement, away from the hypothetical, ideal ordering, i.e. the crystal imperfections, to a very large extent determine the properties of materials. This non-ideality is comprised by the notion "microstructure" in materials science. It encompasses in particular the concentrations and distributions of defects as vacancies, dislocations, stacking and twin faults, the (associated) lattice distortions due to strains/stresses, the crystallite size and its distribution, and also the compositional inhomogeneity. The diffraction-line broadening methods devoted to this type of analysis have been summarized under the heading "size-strain analysis" and this explains the nickname of the conference series.

The roots of "size-strain analysis" can be traced back to shortly after the discovery of the diffraction of X-rays by crystals. In 1918 Paul Scherrer, in Göttingen, presented what is now called the Scherrer equation for the determination of crystallite size from the line width. The next great step forward was the recognition that not only the finite size of the crystallites gives rise to diffraction-line broadening, but that in particular lattice distortions ("Verhakungen" was the name used in the original paper; see what follows), especially in engineering materials, can simultaneously induce pronounced diffraction-line broadening as well. Then the major question is how size- and strain-broadening effects can be separated in the observed line broadening. The original work that can be considered as the "birth" of "size-strain analysis" was performed by Ulrich Dehlinger und Albert Kochendörfer, in Stuttgart. They published their results as a paper entitled (translated into English) "Line broadening by deformed metals", which was published in Zeitschrift für Kristallographie, 101 (1939) 134. In the introduction of this paper the following sentence occurs (translated into English): *"It is shown in section 2 that the line breadth can be separated unambiguously in contributions due to crystallite size and strain, provided that the diffraction-angle*

*dependence of the line breadth is known"*. It is fitting that the present proceedings, almost 80 years after Dehlinger and Kochendörfer, also appear in Zeitschrift für Kristallographie, with three of the Editors of the Proceedings having Stuttgart as basis. What is more: these proceedings demonstrate that even today "size-strain separation" is controversially discussed and subject of intensive research, which is partly due to the current availability of, as compared to the "old days", huge computer power, new radiation sources, as offered by synchrotrons, and new instruments.

The "Size-Strain" conferences are held once per three years (previous conferences: Liptovsky-Mikulas (Slovakia, 1995); Freiberg (Germany, 1998); Trento (Italy, 2001); Prague (Czech Republic, 2004)). The dominant themes of the conferences have been:
- lattice defects,
- residual stresses,
- texture in thin films and at surfaces,
- line-broadening analysis and line-profile fitting, and
- diffraction/microstructure modeling.

For "Size-Strain V" in Garmisch-Partenkirchen (Germany, 2007) this has not been essentially different, but, as can be recognized by reading the current proceedings, special emphasis was paid to "nanocrystalline materials, "plastic deformation", "planar faulting" and "instrumental techniques", in view of the recent developments in the field.

There is not much literature focusing on the "Diffraction Analysis of the Microstructure of Materials" in a concentrated way; most of the relevant work is published in a highly scattered and not always easily retrievable way. Therefore we end with a brief listing of publications which do provide such in-depth overviews:

- R.L. Snyder, J. Fiala and H.J. Bunge (Eds.), *Defect and Microstructure Analysis by Diffraction*, Oxford University Press, New York, 1999.

- E.J. Mittemeijer and P. Scardi (Eds.), *Diffraction Analysis of the Microstructure of Materials*, Springer, Berlin, 2004.

- E.J. Mittemeijer, U. Welzel and R. Kuzel (Eds.), *"State of the Art of Powder Diffraction"*, Zeitschrift für Kristallographie, 222 (2007) issue 3-4 (pp. 105 – 209).

- and then, of course, the current proceedings…….

Eric J. Mittemeijer
Andreas Leineweber
Udo Welzel

Stuttgart, August 2008

Paolo Scardi

Trento, August 2008