Utilization of stereology for the characterization of material microstructure

Maroš Martinkovič

Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava, J. Bottu 25, Trnava 91724, Slovakia

All materials consist of a lot of the same or different atoms. The properties of this system depend on its composition, macro and microstructure. The material structure is formed during production, treatment and utilisation of the material. The importance of microstructure in the control of properties of materials (metals, alloys and other materials too) is well recognised. There is necessary to specify and control microstructure in quantitative terms. It means to carry out a measurement on the two dimensional plane of a metallographic cut (quantitative metallography) and the magnitudes of the microstructural features in the three dimensional material (stereology).

Characterization of material microstructure consists of:

Structural types and its main characteristics - definition and characteristic of microparticles**,** types of structures, single phase and multiphase structures, isometric and oriented structures.

Quantitative parameters of the structures - definition and material application of volume fraction, specific surface area, specific line length per area, specific line length per volume, orientation of structure, shape of microparticles, number of particles per unit volume, mean value and particle size distribution, distance between particles.

Measurement and calculation - direct reconstruction, statistic reconstruction, derivation of basic stereology equations, measurement using the line coincidence method and oriented line method, measurement of point fraction, line fraction and area fraction, accuracy of measurement, methods for obtaining of spatial size distribution of particles from the size distribution of their planar section (area, diameter or chords).

The utilization of sterology metallography allow very simple and effective experimental estimation for the characterization of material microstructure.

This work was supported by the Slovak Research and Development Agency under the contract No. APVV-15-0319 and by the VEGA Grant No. 1/0122/16 of the Grant Agency of the Slovak Republic Ministry of Education.

[1] S.A. Saltykov, Stereometriceskaja metallografija (in Russian), third ed., Metallurgia, Moskva, 1970.

[2] E. E. Underwood, Quantitative stereology, Addison-Wesley Pub., 1970.

[3] M. Martinkovič, Kvantitatívna analýza štruktúry materiálu (in Slovak), STU, Bratislava, 2011.