# Editorial

Janez Grum

Here we have the first issue of a new journal titled *International Journal of Microstructure and Materials Properties* (IJMMP). The themes of the contributions in this journal focus on issues related to the description of material microstructures and material properties. From a historical perspective, it can be seen that experts have always focused on material properties at the beginning of their research. These material properties then determined material behaviour under various operating conditions. The beginnings of material testing were initially based on hardness testing and, later on, progressed to material strength. The introduction of light microscopes into field of material study made it possible for experts to relate material microstructure to material properties. An increase in the number of different materials and, consequently, new material applications required the development of adapted material testing methods. Initially, the majority of materials were used only for the structures of which certain physical properties (*i.e.*, mechanical properties) were known. Nowadays, state-of-the-art and technological advances of new materials require the treatment of very specific material properties (*e.g.*, of components for the electronic industry).

Looking back at the beginning of the 19th century, we see that engineers at that time took great interest in the accuracy of manufacture of the parts making assemblies since it was the key to the quality operation of the entire assembly. Also during that time, engineers and technicians started thinking ways on how to improve the dimensional accuracy of parts. They encountered a new problem – that of part strains due to internal stresses occurring after mechanical and heat treatments and with uniform solidification of castings. This problem entailed the improvement of testing techniques, the production of new devices for the measurement of product size and the development of new devices and techniques for the determination of various physical material properties. Numerous methods were developed to measure residual stresses of materials by measuring relaxation (*i.e.*, strain). Also, simultaneous comprehensive studies of microstructures together with these measurement methods were undertaken. The results of these studies made the causes for the occurrence of residual stresses more evident. Thus, engineers sought relations between strains of machine parts. They also calculated residual stresses on the basis of their existing knowledge of microstructures and the technological history of a material. Consequently, these efforts by the engineers led to two developments. First, destructive methods for the measurement of residual stresses at adapted specimens were developed. Second, Non-Destructive Testing (NDT) methods for the measurement of residual stresses in machine parts were developed. As far as the measurement of residual stresses is concerned, diffraction methods have established themselves quite well. Currently, diffraction methods are employed as a tool because they are very practical, efficient and reliable for the determination of residual stresses.

Another very important area in dealing with machine parts is the advances in various techniques to improve operating characteristics of individual assembly parts. In this connection, surface preparation and surface hardening techniques are of major importance. Nowadays, numerous surface treatment methods are treated from the viewpoint of surface microstructure and microgeometry. These methods also take into account the tribologic contact conditions in the operation of an assembly. The tribologic contact condition refers to the relation between heat treatment and thermo-chemical treatment and the improvement of hardness and wear resistance of a refined surface. The operating capacity of assemblies is tested with different wear tests. The results of these tests provide an answer to the relative comparability of surface quality from the viewpoint of different surface refining methods or conditions.

In the last 20 years, we witnessed an exceptional advancement of the methods for computer-aided work. Because of these advances, new options of modelling (*i.e.*, simulation) of various processes were offered. As a result of these options, the verification of different structural solutions was made more efficient. Also, the comprehensive studies of assemblies and devices under operating conditions were made possible. The advancement of different computer-aided experimental and measuring devices and techniques is of equal importance. These devices and techniques provide a good insight into material behaviour with different applications.

The theoretical treatment of diffusion processes and the processes related to plastic strain (known long before the advanced and used experimental techniques) are very important. In the last 60 years, considerable advances occurred in this field. Numerous optical and electronic aids for the quantitative treatment and microstructure analysis were developed. These aids make it easier to understand various processes in a material due to thermal, thermo-chemical or mechanical influences. The knowledge of microstructures and efficient confirmation of diffusion processes permit us to confirm various phenomena in the material during the manufacture of parts, as well as findings on materials and their behaviour with different applications. Thus, researchers and experts have acquired additional knowledge of materials. This knowledge can be efficiently used with new and usually quite varied applications. New structural materials and material advances for various optical and electronic elements and devices require an increasing linkage of science and technology in order to provide for reliable behaviour of materials in an operation. New production technologies and increasingly faster production and machining processes or post-treatment require a new approach to the study of processes. In this new approach, not only mechanical treatment processes but also opto-electronic and electromagnetic processes improving the quality of manufacturing processes and products are treated. This refers to the treatment of rapid material heating and cooling in thermal and thermo-chemical treatment processes as well as the thermo-mechanical treatment of materials and various treatment techniques for the manufacture of cast and sintered materials. Numerous new and hybrid treatment techniques have been born. They require complex knowledge of technological influences on the material in a manufacturing process.

At the beginning of the publication of the journal, let us wish that the contributions may attract a wide audience of experts on materials, various manufacturing technologies or various operating conditions. Also, let us hope that, in the future editions of this journal, spontaneous contributions of researchers on their accomplishments in this field may be offered.