M5-7 Possible Application of Laser Scanning Confocal Microscopy in Material Science

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Microscopic techniques have undergone a long development which has accelerated remarkably in recent decades. The possibilities of microstructural analysis have been broadened in recent years with the coming of a new generation of advanced microscopes, such as the laser scanning confocal microscope (LSCM). The first LSCM was constructed in 1967 for biological applications, however only the combination of the confocal principle and a laser source resulted in a powerful microscope which combines the advantages of both light and scanning electron microscopes. This paper shows several selected applications of the OLYMPUS LEXT OLS 3000 laser scanning confocal microscope in Material Science. LEXT enables observation in a light microscope mode with magnification of up to 2400 or in a confocal mode with magnification of up to 14 400. Even the highest magnification can be achieved without the need to ensure a vacuum, the conductivity of a specimen or any other special requirements typical for the techniques of electron microscopy. LEXT furthermore encompasses a system for three-dimensional reconstruction of surfaces which is accompanied by a software tool for image analysis. This enables us to obtain an exact image of surface relief and to utilize various plane or stereometric measurements on this surface.

One of the most common tasks of microscopy in material science is microstructure characterization of etched scratch patterns. However, the magnification of a light microscope is not high enough for some applications, for instance to distinguish very fine phases in multiphase microstructures of steels. LSCM can be successfully employed in these cases, for example to identify retained austenite islands in transformation induced plasticity (TRIP) steels (Fig.1).

Another advantage of LSCM is the high accuracy of surface relief measurements. This feature was used in the verification of notch shape of miniaturized test samples for impact test. The depth and radius of the notch were established from the reconstructed surface (Fig.2.). Fracture surfaces were also observed by LSCM after the test (Fig.3, Fig.4). Reconstruction of surface relief was furthermore utilized in the analysis of thickness and consistency of lubricant layers on forming tools (Fig.5). LEXT´s software embodies not only the common functions of image analysis but also a roughness measurement module, which was successfully used to check the surface quality of rolled thin sheets (Fig.6) with different treatments.

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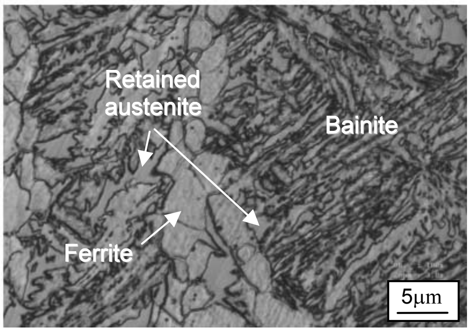

Fig.1: Microstructure of TRIP steel.

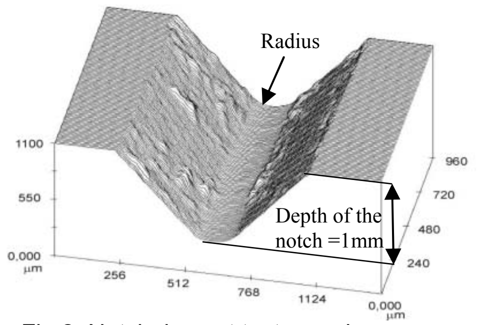

Fig.2: Notch, impact test sample.

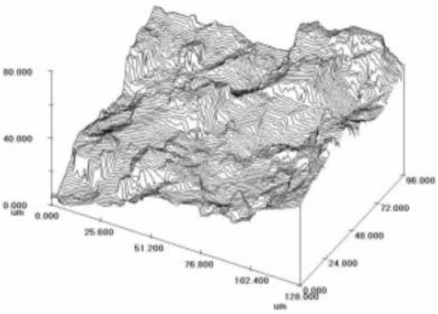

Fig.3: 3D surface reconstruction of fracture surface.

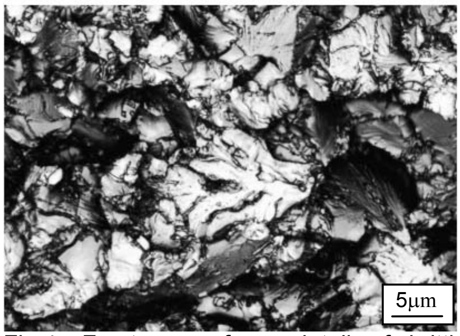

Fig.4: Fracture surface, detail of brittle facets.

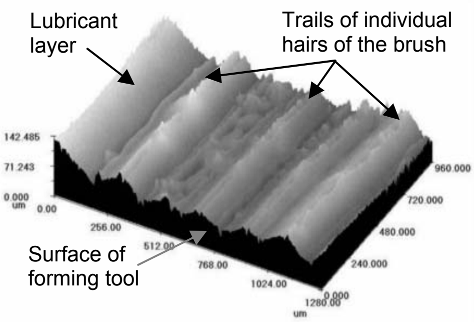

Fig.5: Lubricant layer spread on forming tool by a brush.

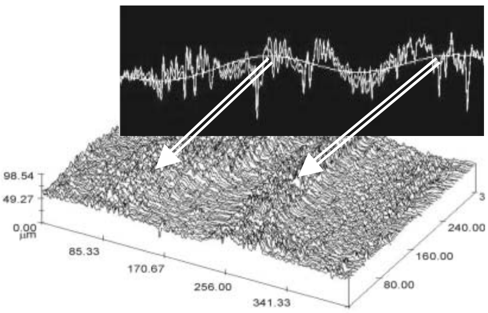

Fig.6: Rolled surface and its roughness profile.