Topocrom GmbH • Hardtring 29 • 78333 Stockach • Germany
Topocrom Systems AG • Fohlenweide • 8750 Weinfelden • Switzerland
info@topocrom.com • www.topocrom.ch

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3D scanners and the topography of cold-rolled steel

The new PRETEX® technology developed by Salzgitter AG is tailored to meet current and future demands with regard to complex forming processes on state-of-the-art transfer presses, as well as to the coating quality of large car body parts. Salzgitter Mannesmann Forschung now deploys confocal white-light microscopy, which allows the scanning of technical surfaces at a topographical resolution in the nanometer range.

During the processing of flat rolled steel products at the customers' sites, contradictory objectives reveal the limitations in current technology. On the one hand, the processing company must minimize costs by reducing the number of process phases, while, on the other hand, having to handle the increased complexity of produced components. These technological processes demand optimization of the classic material parameters, of forming limit characteristics, and of friction states generated by tool contact with the material. At the same time, the visual appearance of the complex, formed and painted component must also meet the highest demands. Therefore, the microstructure of the surface of cold rolled steel represents a product feature that is decisive for meeting quality requirements, for example, for automotive applications. It is also a vital aspect in terms of forming characteristics and of adhesion and visual properties of car body painting.

The topography of cold rolled steel is tuned within the final rolling process, known as skin passing, in order to optimize forming and painting properties for further processes. Long-wave structures are relevant to results of the painting process, whereas short-wave textures are decisive for results of the forming process. Salzgitter Flachstahl has developed and deploys an enhanced PRETEX® structuring technology. PRETEX® is the abbreviation for PREcision TEXturing and involves the homogeneous distribution of structures on the material surface by means of hard chromium, hemispherical textures on the roller surface. This technology allows the production of tailor-made surfaces for all types of applications. The specific surface structure of the cold rolled steel requested by customers is produced by means of a post-rolling process in the skin pass mill stand that transfers the surface structure of the textured working roller to the non-coated or finished surface of the cold rolled steel.

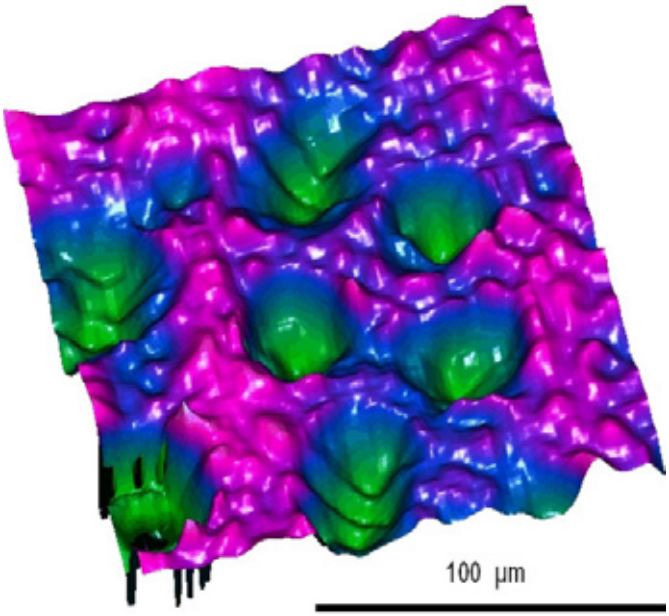

Fig. 1: *3D structure of the PRETEX® rollers.*

Salzgitter Mannesmann Forschung now examines the PRETEX® topography of the skin pass rollers and of textured steel products by means of confocal microscopy, with results forming the basis for controlling and optimizing processes.

The non-contact confocal white-light scanner and high-resolution scanning electron microscopy (SEM) complement one another. SEM provides images of the object surface, whereas the confocal scanner generates evaluable topographical data. This technology allows the examination of the surface and lines of microstructures on a micrometer scale (min. 1µm to 2 µm) up to long-wave structures and curvatures in the mm and cm range at a topographical resolution of approx. 10 nm. Particular specimen preparation for measurement is not necessary.

The automated measurement, visualization, analysis and design of the 3D structure of the PRETEX® rollers and of the cold rolled steel topography (Fig. 1) form the main fields of application of confocal microscopy at Salzgitter.

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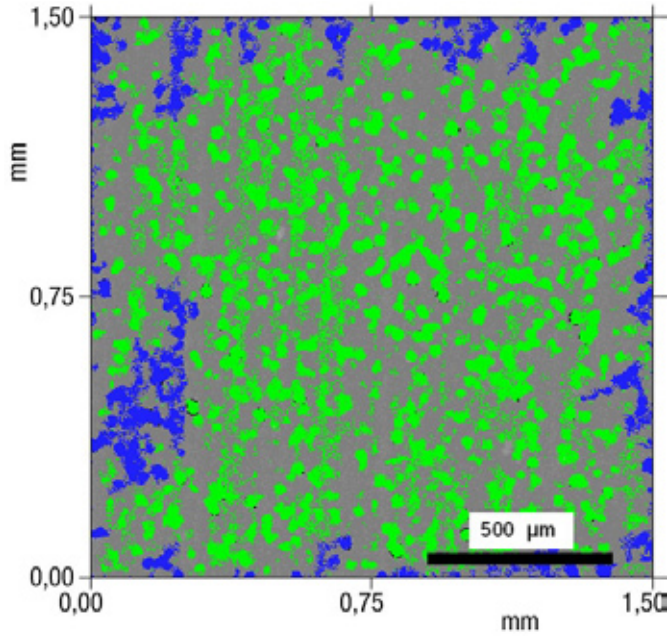

Fig. 2: *Two-dimensional figure of a lubricant reservoir of the PRETEX® structure*

Analysis of the cold rolled steel product is based on clearly specified properties (parameters), including all conventional roughness and waviness parameters (2D and 3D), the topographical image, any topographical profiles in the 3D image, the Abbot curve (reflects the height dependent material component), void areas, associated volumes and so forth). The analysis particularly covers open (blue) and closed (green) void area and material ratios (grey; Fig. 2), the associated volumes and additional 3D topography parameters in order to achieve an application-specific optimization of the PRETEX® structure. The term open in this context refers to areas where lubricants can be routed to the outside during forming, by contrast to closed cavities where the oil is retained during forming.

The focus is also set on defining topography parameters beyond the arithmetical mean value of roughness Ra and of peak value RPc. Although the latter parameters are included in most specifications, these usually do not adequately describe the surface in terms of oiling and forming properties for deep-drawing. Using confocal microscopy in determining surface properties of rolled steel has already returned additional information for optimizing the forming process.

Information:
http://www.salzgitter-flachstahl.de/en/News/Archiv/2007/3D_Scanner_und_Feinblechtopographie/