Electro-polishing

The Measurement Task
For electro-polishing, the work piece is dipped in an electrolyte and used as an anode. Current flowing from the cathode works with the electrolyte to remove metal from the work piece surface, preferentially from the surface peaks. The optical and technical properties of the metal surface can be suitably influenced by this. The company Odersun AG uses this process to smooth copper strip to be used as the base material for production of modern solar cells. To achieve a uniform surface quality, continuous monitoring of the electro-polishing operation is desirable.

Solution
The OptoSurf OS 500 scattered light measuring instrument is highly ideal for this task, since the distribution of scattered light correlates directly with the profile angle distribution.
The sensor, with a 0.9 mm diameter light spot, is easily mounted directly after the polishing station and captures the optical roughness value S_o as well as the standard deviation.
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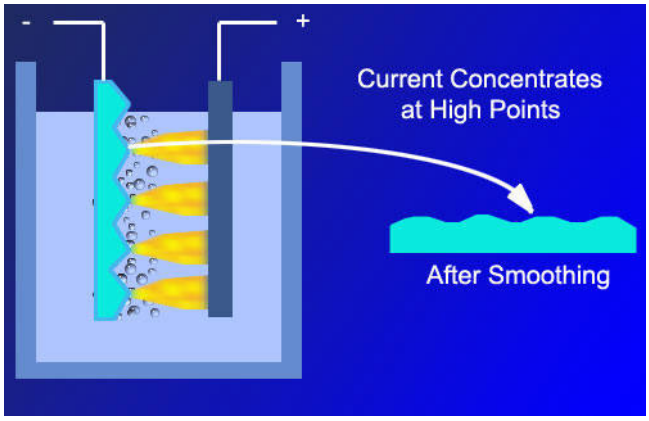
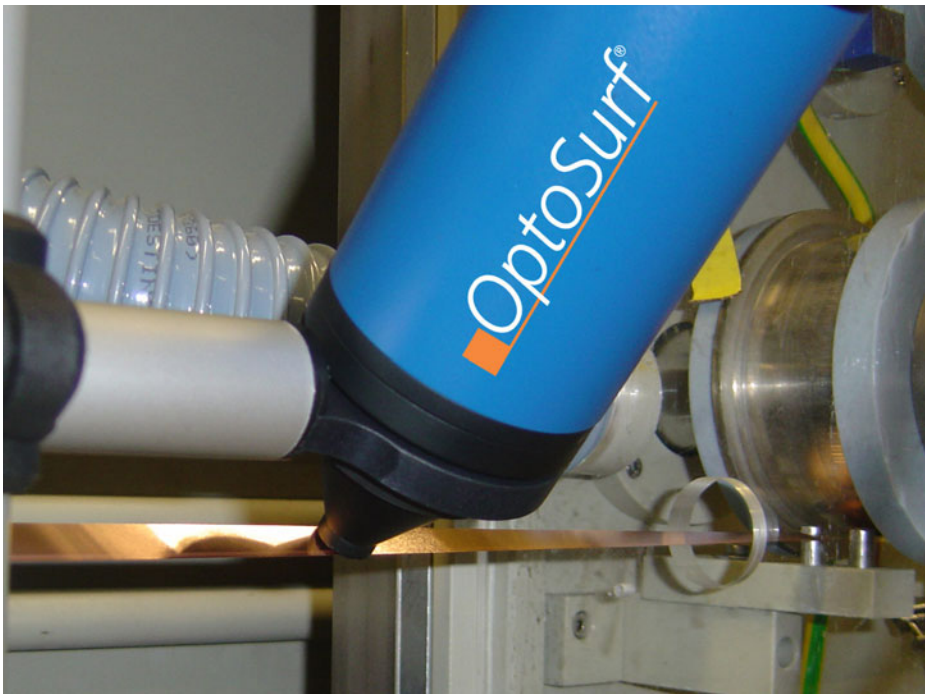


Electro-ploishing process: Smoothing effect through evening of peaks. (NuGenTec)

- **Polishing quality**
- **Profile angle distribution**
- **Cross-wise and long-wise roughness**



In=line measuremnt of polished copper strip with the OS 500 at the output of an electro-polishing process (Odersun AG, Frankfurt an der Oder, www.odersun.de)

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Results

The sensor makes 200 separate measurements every 300ms on the moving copper strip. From individual measurements an average value (μS_o) and the standard deviation are calculated and displayed graphically.

For quantitative analysis of the surface, the 3D confocal microscope from NanoFocus was employed. With the help of this confocal measurement system, topographical values were captured and roughness characteristic values calculated. Especially important here is the determination of the profile angle parameter R_{dq}, which correlates with the optical value S_o. By comparison, the S_o value can be converted to the DIN EN ISO value R_{dq}. For process montioring, however, the S_o value suffices.

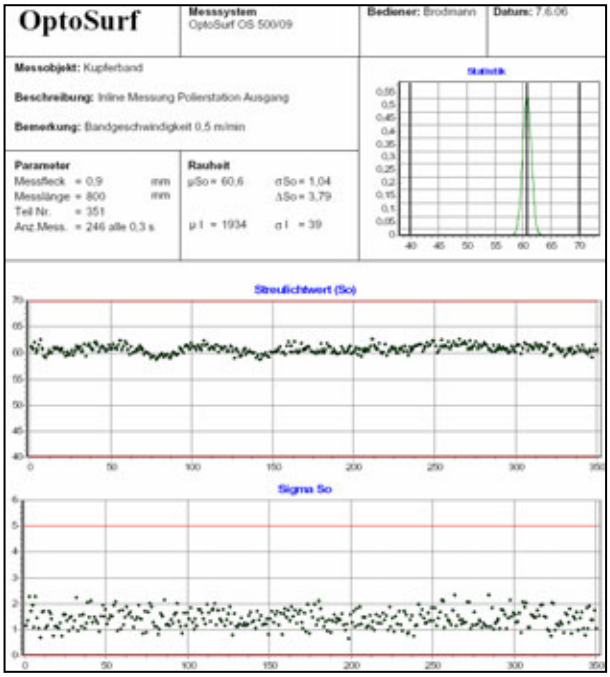
The optical roughness runs from S_o = 85 (with electro-polishing switched off) to S_o = 46 (strip running through the process at 0.3 m/min). The polishing process can therefore be monitored by setting upper and lower limits.

The calculation of standard deviation from the respective 200 measurements allows appraisal of the homogeneity. If the standard deviation is too high, then either the ouput material is not sufficiently homogeneous or the polishing process is fluctuating.

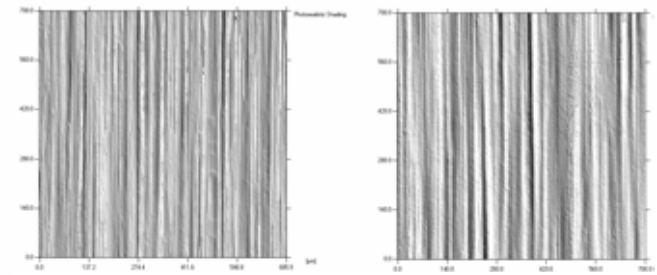
Highlights

The scattered light measuring process is essentially independent of the speed of movement of the surface. That means the roughness characteristic value S_o reacts only to the polishing changes.

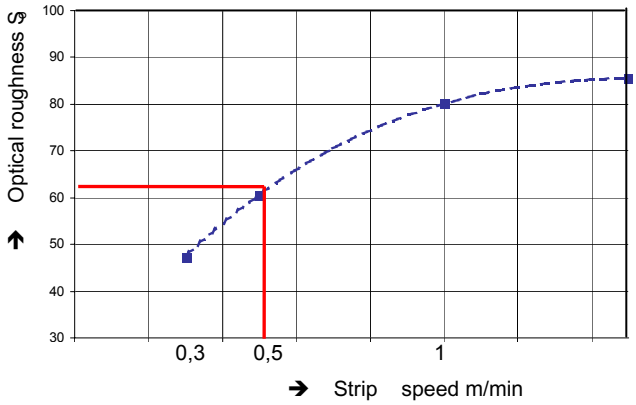
For a complete analysis of the surface, the OS 500 sensor can also be turned through 90° in the azimuthal direction, to measure the lengthwise roughness. Additional information is then available, regarding changes in the texture of the surface.



So distribution at 0,5m/min strip speed, measuring time 2min



NanoFocus µSurf measurements. left: unprocessed; right 0,5m/min



Smoothing effect (=smaller So values) at lower strip speeds (=longer electro-polishing) red: optimal working point

In the UK, contact : Systegration Ltd., 98 Sea Road, East Preston, Littlehampton, BN16 1NP Tel. 09103 784103 E-mail : sales@systegration.ltd.uk