

Technical Note

Tribo Finish "LHTF-01"



Introduction

For many critical precision tools as used in various high-end applications, a tight control over the product surface finish is becoming an increasingly important requirement. The surface texture, the topography and the subsurface characteristics are becoming primary key factors determining the ultimate product functionality. Machining marks, subsurface damage patterns, and oxidation layers must be removed effectively without degrading the precision elements or critical features. In order to achieve this, technologies are to be used which are fully compatible with the demanding environments involved, like for instance Ultra High Vacuum [UHV] and Ultra Clean Vacuum [UCV] process environments. Traditionally, techniques like etching, passivation, and electrochemical polishing are generally used for this purpose. From a cleanliness and homogeneity perspective, these processes are not ideal as [cross] contamination and product degradation or damage can easily occur.

For more than 20 years now, Louwers Glass and Ceramic Technologies has been producing a wide range of glass-to-metal feedthroughs and special assemblies. Unique direct bonding technology is used to achieve the highest possible level of vacuum sealing and electrical isolation, without the presence of unnecessary transition interfaces, and/or virtual leakages. For oxide layer removal and surface finishing, etching/passivation and electrochemical polishing [ECP] were previously used as standard technologies. Driven by the increasing demands for high-end applications [a.o. EUVL lithography and electron microscopy], Louwers has closely worked together with MST Agion to develop, test, and qualify an alternative next-generation process for the oxide removal and special surface finishing of critical metal components and glass-to-metal products. The process involved is a tribological texturing technique, using a special mixture of high quality granulates. The main advantages of this process arise from the fact that both a clean and a dry process is involved, not leaving any contaminants or fluids at the product surface. Tightly controlled, deburred, and passivated surfaces result, meeting all next-generation requirements, even for the most demanding applications.



Tribo Process

The basics of the tribo finishing process have been used for the finishing of precision moulds and critical tribology products for a long time already. In a close co-operation between MST Agion and Louwers, this process was developed further in order to meet even the most demanding requirements for high-end UHV and UCV applications, like for instance electron microscopy and next-generation lithography. In figure 1 below, an example is shown of the general surface effect of the tribo process.

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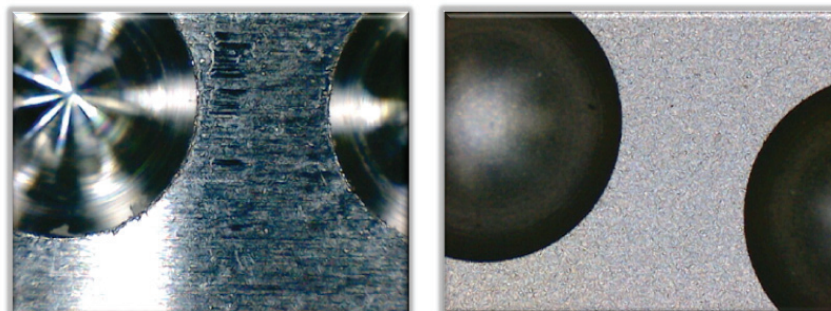


Figure 1: Typical surface textures: left machined surface, before tribo-treatment; right after tribo-treatment.

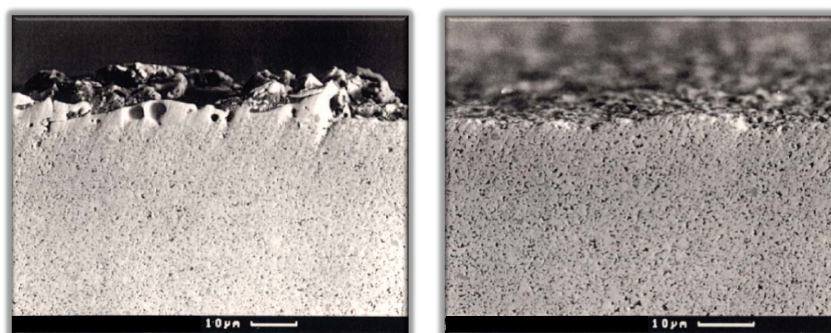


Figure 2: Cross-sections of typical stainless steel surface textures: left before tribo-treatment [typical Ra 0,25-0,30 micrometer] and right after tribo-treatment [typical Ra <0,20 micrometer].

The tribo process consists of two or three consecutive process steps, depending on the requirements and the application involved. In the first process step, a [sub]micrometer thin surface layer is removed, resulting: a) the effective removal of subsurface damage patterns, b) the removal of surface oxide layers, and c) the removal of surface contaminants and particles. In the second process step, the cleaned surface is densified and smoothed, resulting a dense, smoothed, and passivated surface. During an optional third process step, further smoothing and densification can be achieved, which is typically used for critical tribology components such as high-end bearings. As a standard, for glass-to-metal feedthroughs, the two-step process ["LHTF-01"] is used with a subsequent clean room cleaning and particle removal processes in order to achieve the required final cleanliness and surface quality. As an additional option, the tribo finished surface can be post-polished at Louwers, using a diamond granulate polishing treatment. In figure 3, the typical surface structures and roughness patterns are shown for stainless steel metal surfaces after machining [left], after the tribo process step 1 [middle], and after tribo process step 2 [right]. In figures 4 and 5, the AFM pictures are shown for the same surfaces.

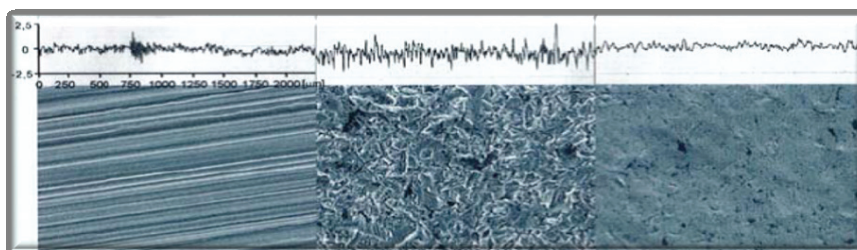


Figure 3: Surface roughness and homogeneity patterns during different phases: left surface topography before tribo-treatment; middle after Tribo process step 1 [cleaned surface], and right after Tribo process step 2 [smoothing and passivation].

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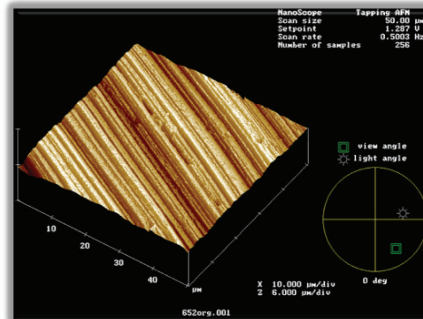


Figure 4: AFM-picture of a typical machined metal surface before Tribo treatment.

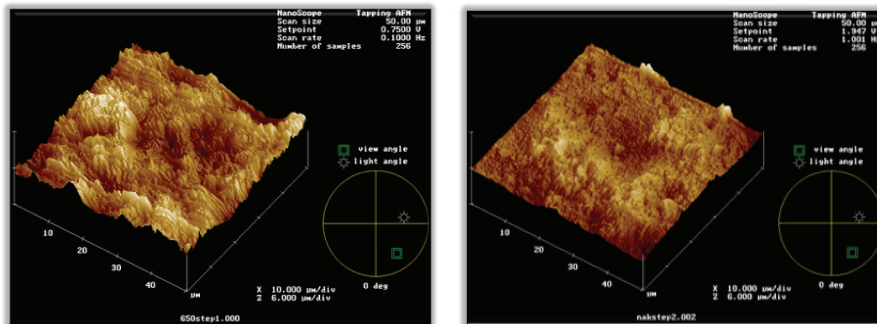


Figure 5: AFM-pictures of tribo treated machined metal surfaces: left after tribo-treatment, step 1 [cleaned surface] and right after tribo-treatment, step 2 [smoothed and passivated surface].

When the "LHTF-01" process is applied onto Louwers' glass-to-metal feedthroughs, oxide free, homogeneous and very clean product surfaces result. As an example, the effect of the "LHTF-01" process on the Louwers feedthroughs is shown in figure 6 below.

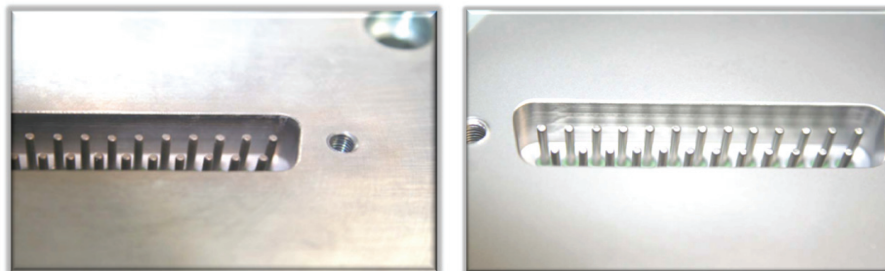


Figure 6: Assembled glass-to-metal feedthrough units: left without tribo finish => interferometric colours are visible due to the oxide layer; right with tribo finish => homogeneous, oxide free, smooth, and clean surfaces.

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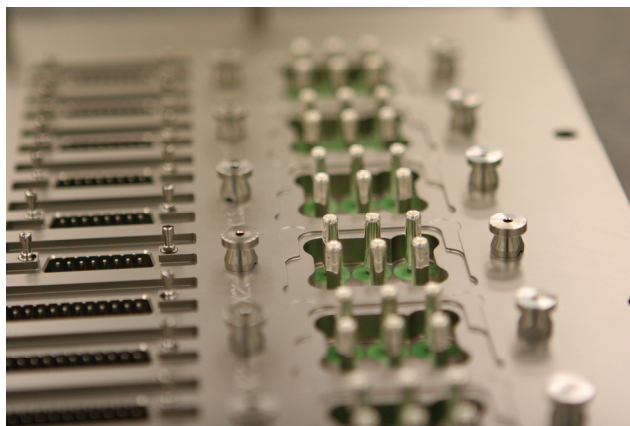
Summary

The tribo finish process in general and the "LHTF-01" process in specific, have the proven capacities for the effective and controlled removal of surface oxide layers and surface contaminations. Furthermore, subsurface damage patterns, e.g. resulting from spark erosion or CNC machining, can be removed and improved tribology properties can be achieved. The process has the proven capability to meet the highest requirements and demands and can therefore be considered as the next generation finishing process for high-end applications.

Amongst others, the tribo process offers the following benefits:

- Highly effective and tightly controlled removal of surface oxide layers;
- Superior removal of [sub]surface contaminations;
- Unique removal of subsurface damage patterns and residual machining mark patterns;
- Tightly controlled deburring of sharp edges and critical features;
- Reduction of contamination sticking to the treated surface, resulting xenophobic properties;
- Surface texture smoothening and densification, optionally followed by additional process steps;
- Improved surface passivation, resulting ultimate corrosion resistance properties;
- Improvement of the tribology properties, resulting extended durability and product life time;

Interested in what benefits the tribo process can offer for your product portfolio and your special applications? Please contact your sales representative at Louwers Glass and Ceramic Technologies for further questions, information, and inquiries.



"Louwers Connects in Ultra High and Ultra Clean Vacuüm"

Dit project is mede mogelijk gemaakt door een bijdrage uit het Europees Fonds voor Regionale Ontwikkeling in het kader van OP-Zuid. De middelen zijn ook afkomstig van het Rijk.



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