

# **TiN Coating of RF Power Components for the European XFEL**

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## Abstract

Thin TiN layers on surfaces of RF components have the ability to reduce secondary electron emission and multipactor effects. A new equipment was designed and built for mass production at DESY to generate TiN films by deposition of Ti vapor in low pressure ammonia ambience. This new setup was already transferred to industry for the XFEL RF coupler production. The technical layout of the apparatus and results of SEM/EDX surface analysis will be presented.

#### **General Setup**



Figure 1. Schematic layout of the Setup

#### Technical features:

- Cylindrical stainless steel vessel, 0.7m diam. 1m height
- · Coating up to 20 ceramics simultaneously possible
- · Coating of inner and outer surface in one process
- · Face side coating of up to 20 ceramics possible
- Coating of a 1.3 GHz waveguide RF window possible (Fig.4)
- Pure Titanium wire (99.8%) used as sublimation source
- · Wire fitted with springs to avoid elongation while heating
- · Conversion to TiN takes place in low ammonia atmosphere
- · Preheating of the substrate to ensure better deposition

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Purity of material (Ti)	99.8%
Heating current	23 A
Duration	60s
NH <sub>3</sub> pressure, coating	5 x 10⁻⁴mbar
NH <sub>3</sub> pressure, postprocessing	15 – 20 mbar
Wire temperature	1700 °C
Wire temperature, preheating	1000 °C
Surface resistivity after 24 h	10 Mohm/sq
Surface resistivity, after 72 h@air	1 Gohm/sq

Table 1. Characteristic coating Parameter



#### Figure 2. CAD drawing of inner assembly



Figure 3. Inner assembly



Figure 4. Setup for waveguide window coating

#### **Surface Analysis**

SEM/EDX surface Analysis was done at DESY and at Oberflächeno.f.u. Gesellschaft für und Festkoerperuntersuchungen/Hamburg. A depth Profile Analysis with Glow Discharge Optical Emission Spectroscopy (GDOES) was done at o.f.u. as well.





Figure 5. REM-exposure of a ceramic Sample

Figure 6. REM-exposure of a TiN coated ceramic. The marked area is the 25nm thick TiN Layer





Figure 8. EDX spectrum of a TiN coated Al<sub>2</sub>O<sub>3</sub> Sample



Figure 9. EDX spectrum of a TiN coated Sample from O.f.U.

Figure 10. Depth profile Analysis done with GDOES at O.f.U.

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### Summary

Sample ...

With this Setup it is possible to coat XFEL Coupler components in a batch production scale. Because in situ measurements of the laver thickness is not possible, we analyse the laver after the process with SEM/EDX and GDOES to find a optimal parameter set for coating. Since spot tests has to be done from time to time a reasonably fast and easy method has to be found .



