Coating inside tubes

Thin film deposition inside tubes for high-end applications

Introduction

The Tribology Centre at Danish Technological Institute has set up a PVD coating facility capable of coating thin films on the inside of both conducting and nonconducting tubes. The thin film is deposited by magnetron sputtering by moving a sputtering cathode and anode inside the tube.

The coating facility can handle tubes with a length up to one meter and dimensions down to 22 x 40 mm2. Titanium coatings are readily available, but other metals can be deposited on request.

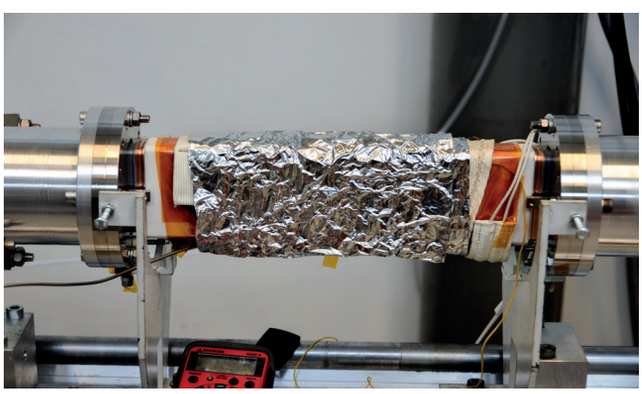

Figure 1:
40 cm long Al2O3 ceramic tube during inside coating by titanium at 150 oC. The ceramic tube is wrapped in aluminium foil to obtain a homogenous surface temperature.

Application

So far, ceramic Al2O3 tubes for storage ring/accelerator facilities have been coated with titanium on the inner wall to achieve a target specification of the flange-to-flange electrical resistance of 5.3 Ω at a deposition temperature of 150 oC. Figure 1 shows the Al2O3-tube mounted in the tube-coater whereas Figure 2 shows the tube after the titanium layer has been deposited.

The present tube is for an injection kicker magnet for the Synchrotron-Light source for Experimental Science and Applications (SESAME) in Jordan.

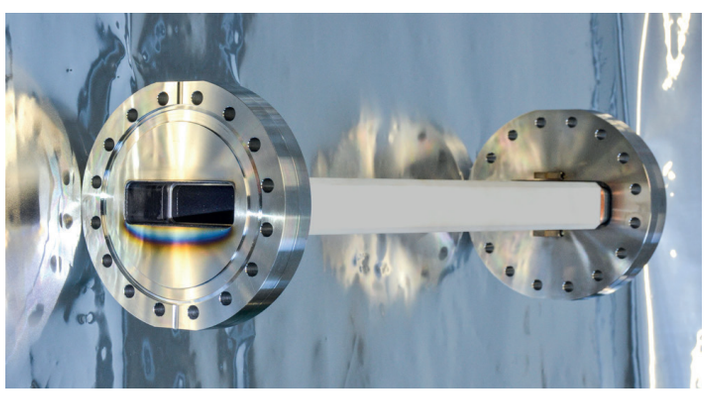

Figure 2:
Ceramic Al2O3 tube after coating the inside with titanium. The tube has been coated by titanium until the flange-to-flange electrical resistance has reached 5.3 Ω at 150 oC. The tube is for an injection kicker magnet for the SESAME synchrotron.

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QUALITY SYSTEM CERTIFICATION DNV ISO 9001

DANISH TECHNOLOGICAL INSTITUTE

Properties

Thin film coating	
Inner tube dimensions (L x W x H)	<1000 mm x (20-200 mm) x (44-200 mm)
Deposition temperature	Ambient temperature to 180 °C
Base pressure	~10^{-7} mbar or ~10^{-5} Pa
Flange to flange resistance	~2 Ω to 100 Ω, depending on geometry

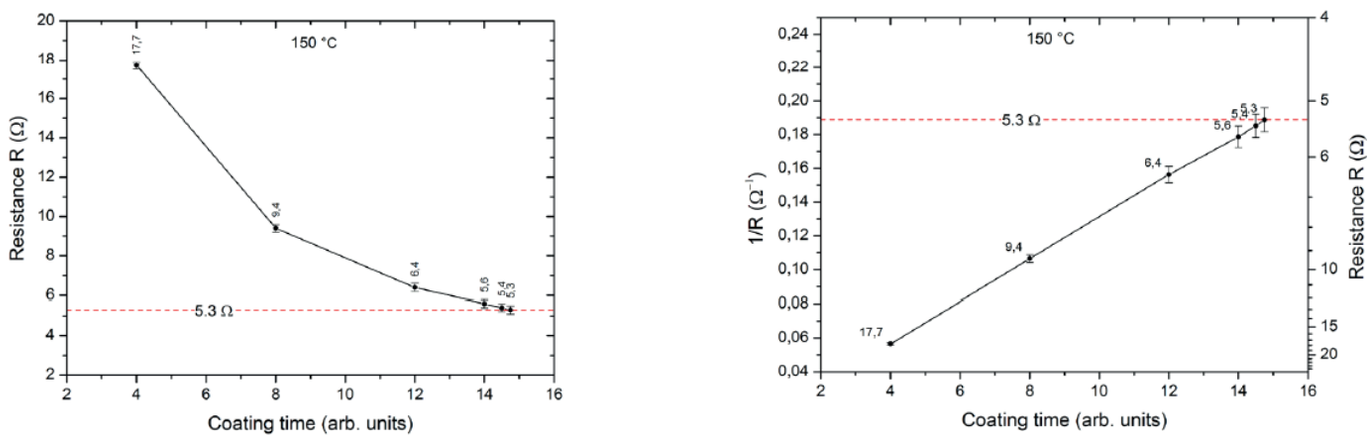

Figure 3
The actual titanium thickness meeting the specifications of a tube flange-to-flange resistance of 5.3 Ω depends critically on the actual surface roughness of the tube. Thus, the titanium thickness is gradually increased by moving the sputtering source back and forth during deposition until meeting the specifications.

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