DANISH TECHNOLOGICAL INSTITUTE

NEWSLETTER DTI TRIBOLOGY CENTRE

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PVD coating of permanent magnets for Big-Science applications

At the Tribology Centre, Danish Technological Institute, we have developed a chromium nitride (CrN) and a titanium nitride (TiN) process suitable for coating neodymium magnets for synchrotron insertion devices such as wigglers and undulators.

Strong permanent magnets are often based on the rare-earth metal neodymium. Combining neodymium with iron and boron and sometimes also cobalt, dysprosium and praseodymium creates the strongest permanent magnets in the world.

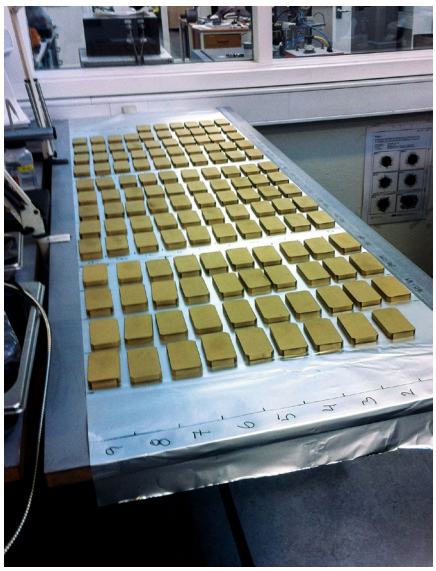
The fabrication of neodymium magnets is a rather complicated process where the raw materials react at a high temperature under vacuum conditions through inductive heating. The reacted product is subsequently milled into a homogenous powder followed by pressing, sintering and machining into e.g. discs, blocks, rings, etc. Before magnetizing the neodymium magnets, it is necessary to protect them, since unprotected neodymium magnets are highly prone to corrosion. The magnets are also known to lose their magnetic properties in the presence of moisture. Neodymium magnets can be corrosion protected by conventional galvanic plating processes or by plasma-based PVD coatings.

Corrosion protective electroplatings are often based on nickel- or copper-containing electrolytes.

Alternatively, neodymium magnets can be protected by hard wear-resistant ceramic coatings such as e.g. chromium nitride (CrN) or titanium nitride (TiN) deposited by reactive PVD. The benefit of PVD coatings is a better adhesion, and furthermore, there is no wet chemistry involved that may interact with the (NdFeB)-magnets. Coatings with CrN or TiN will result in a metallic or gold-like appearance, respectively.

TiN coated neodymium magnets ready to be debatched.

Synchrotron insertion device designed and built by Danfysik.



Quality control of neodymium magnets PVD coated with TiN.

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