



NEWSLETTER DTI TRIBOLOGY CENTRE

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New TiN coating for temperature-sensitive base materials

Introduction

TiN is a well-known hard and wear-resistant coating with a characteristic yellow-golden colour. It is not only used in diverse industrial segments to improve performance and lifetime of tools and components but is also used for decorative purposes. Usually, obtaining a good coating quality requires a high temperature during deposition, preferentially above 400 °C, which excludes the deposition of TiN on temperature-sensitive substrates like e.g. hardened low alloy steels, martensitic stainless steels, some cold work tool steels as well as a number of magnetic materials.

HiPIMS

Using the special deposition technique High Power Impulse Magnetron Sputtering (HiPIMS), it is possible to deposit TiN at temperatures as low as 130 °C. The major difference between HiPIMS and the standard DC sputtering process is the operating mode of the targets. Standard sputtering is operated at a constant DC voltage of about minus 400 V. In the case of HiPIMS, the targets are pulsed and reach much higher power values in much shorter time intervals. The short pulses in the HiPIMS mode (typically 5 µs to 50 µs) are widely separated in time, as shown in Figure 1. The energy in each pulse is extremely high, whereas the average

power is comparable to that of conventional DC processes. The high energy in each pulse gives the depositing species enough energy to form a high-quality coating. However, since the energy is only present in a very short time, no appreciable heating takes place. Typically, coatings grown using HiPIMS are denser and smoother compared to standard DC-sputtered coatings.

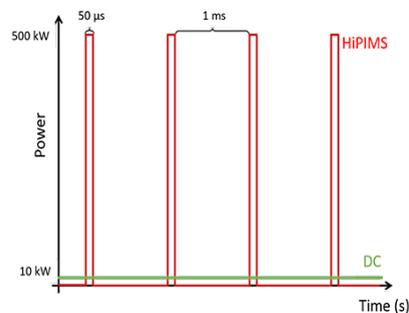


Figure 1: The power output as a function of time. The green line illustrates the constant power (10 kW) applied in a DC process. In contrast, the power in a HiPIMS deposition is significantly higher, but only in short bursts.

TiN-HP-LT for temperature-sensitive substrates

Using HiPIMS deposition, it is possible to keep the deposition temperature of TiN as low as 130 °C and still obtain high hardness. This implies that the choice of base materials is no longer restricted to temperature-resistant materials. The hardness, ductility and adhesion of the new TiN coating is

similar to that of the traditional TiN coating deposited at high temperature. The key features of the low-temperature TiN compared to standard TiN is summarized in the table below.

Coating type	Deposition Temp. (°C)	Hardness (HV)	Colour
Standard TiN	400 - 450	2200	Yellow-golden
TiN-HP-LT	130 - 150	2100	Yellow-golden

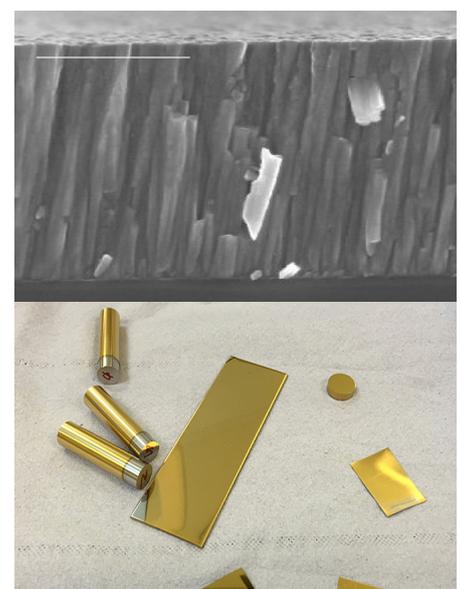


Figure 2: Top: Cross-sectional SEM image of the new TiN-HP-LT coating deposited on a Si substrate. The scale bar is 500 nm. Bottom: Test samples coated with the new TiN-HP-LT coating.

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