Hiden Reference: AP0142
Hiden Product: ESPion Advanced Langmuir Probe

Ion density increase in high power twin-cathode magnetron system

The Optimized Wire Treatment (OWIT) project aims at developing and validating a new deposition technique allowing uniform coatings with exceptional physical properties to be obtained on wires and fibers. Conventional sputtering technique, which utilizes planar targets or point sources, suffers from serious limitations related to the impossibility to deliver a majority of sputtered species to the substrate. We propose a magnetron sputter system operating in High Power Impulse (HIPIMS) mode, which preserves a significant amount of metal ions. These ions are not lost at the chamber walls, but can be utilized repeatedly for the deposition process, maintaining high level of self-sputtering even at relatively low power inputs. New coatings with unique physical, chemical and electrical properties can be obtained with very good mechanical strength, high ageing quality, long chemical and mechanical lifetime.

In order to validate and evaluate the method and deposition technique, the following major objectives are considered:

- Plasma modelling with particle-in-cell (PIC) and Monte Carlo methods using experimental data obtained by means of plasma diagnostic tools. Extensive plasma modelling and calculations are performed in order to determine the optimum properties (geometry, density, field distribution, etc.) of the bulk plasma.
- New technological level in the field of smart processing of wires was achieved. The major difficulty and the originality of this project consist in concentrating high-density plasma in a small cylindrical volume having relatively large length. We aim at creating an appropriate plasma shield around wires in order to deposit and implant simultaneously the constitutive species of coatings. This new plasma configuration implies high deposition rates and thus high treatment speeds. In future, special attention will be paid to achieving perfect cylindrical plasma geometry in order to guarantee homogeneous treatment all over the wire surface.
- Plasma diagnostics by means of Hiden Analytical ESPion Advanced Langmuir Probe have been carried out. The discharge has been analyzed for different power modes during the active phase of HIPIMS plasma generation when the probe was placed in the middle of the discharge volume between four essentially balanced magnetrons. When the cycle contains more than one pulse, the triggering waveform was transformed into a single pulse using a counting device. Triggering was initiated 5 μs before the first edge level of the discharge voltage had been achieved at the beginning of each cycle. In such a configuration, the probe can offer 125 ns resolution for the main plasma parameters such as ion and electron densities, electron temperature, plasma and floating potentials.

The experimental setup with four essentially balanced planar magnetrons (2" Ti targets), Langmuir probe, and the system of capillaries used to introduce wires from atmospheric pressure.

HIDEN ANALYTICAL LTD
420 Europa Boulevard, Warrington, WA5 7UN, England
t: +44 (0) 1925 445225 f: +44 (0) 1925 416518
e: info@hiden.co.uk **w: www.HidenAnalytical.com**

Hiden Reference: AP0142
Hiden Product: ESPion Advanced Langmuir Probe

Project Summary by:
O.V. Vozniy
Département Science et Analyse des Matériaux (SAM),
Centre de Recherche Public - Gabriel Lippmann,
41, rue du Brill,
L-4422 Belvaux
Luxembourg

Paper Reference:
O. Z. Vozniy, D. Duday, A. Lejars, T. Wirtz (2011) "Ion density increase in high power twin-cathode magnetron system" *Vacuum* **86** (1), 78-81

Hiden Product:
ESPion Advanced Langmuir Probe

Follow the link to the product catalogue on our website for further information
http://www.hidenanalytical.com/en/products/for-thin-films-plasma-surface-engineering/ESPion