A NOVEL ULTRASOUND ASSISTED ELECTROPLATING APPARATUS FOR DEPOSITION OF NANO-COMPOSITE COATINGS

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ABSTRACT

Hard Chromium (HC) electroplated coatings have dominated the surface treatment industry for almost 100 years because they can provide outstanding mechanical strength, corrosion resistance and attractive appearance to metallic objects and components [1]. However, the manufacturing of HC coatings requires the use of hexavalent chromium (Cr^{6+}) which is classified as a carcinogenic by REACH. Therefore, companies using Cr^{6+}-based electroplating baths must acquire specific authorization by EC.

Creative Nano is currently investigating the use of Ni and Ni-P matrix nanocomposite coatings reinforced with silicon carbide nanoparticles (SiC NPs) that show high corrosion and wear resistance and comparable hardness to HC [2,3]. Specifically, as part of the EU-funded Sabydoma Project [4], Creative Nano has designed and manufactured **a new medium-scale electroplating apparatus** integrating an ultrasonication probe to an auxiliary tank. The ultrasound assisted electroplating cell produces nanocomposite coatings in which the SiC NPs are homogeneously dispersed with an average particle size of approximately 900 nm, resulting to an excellent microhardness value of 850 $HV_{0.1}$. During the electroplating process, the particle size distribution in the electrolyte bath was monitored via Dynamic Light Scattering (DLS) while under the framework of the NanoPat Project [5] two novel, real-time nano-characterisation Process Analytical Technologies (PAT), namely OptoFluidic force induction (OF2i) and Turbidity Spectrometry (TUS) are implemented to enable automation, digital processing, and on-line quality control. Regarding the environmental impact of the process, the new design resulted in 84% decrease of electroplating wastes (i.e. Ni^{2+}, SiC NPs, organic additives) that are produced upon rinsing.

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KEYWORDS: nanocomposite coating, Ni/Ni-P electroplating, SiC nanoparticles, waste reduction

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