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Manufacturing Nano-rods, nano-wires, 3D net shaped nanocrystlline products by one-step high speed turbulent electrolyte flow

This presentation will introduce the concept of Highspeed turbulent electrolyte flow (HSTEF) electroplating which has recently been invented by the author as a process for depositing nanocrystalline-Ni and alloys directly on nonconductive naturally occurring aluminum-oxide surfaces of aluminum without any pre-treatment. Graphene and related two-dimensional materials provide an ideal platform for next generation disruptive technologies and applications. Nickel nano-rods on the other hand already possess promising properties due to their magnetic behavior and their elongated shape. Highly crystalline nickel, cobalt and alloy nanowires have applications in magnetic/optical sensing and cancer-treatment/biomedicine. However, the most common nickel nanorods are synthesized by electrodeposition into porous templates, the pores of a suitable template are filled with Ni to yield cylindrical nanorods within these pores. In more detail, the template is employed as electrode and immersed in a solution of Ni cations. In a next step, a voltage is applied between the template and a counter electrode so that the Ni cations are deposited inside the pores and reduced to bulk Ni. Additive manufacturing is currently a hot topic in the world of manufacturing where instead of taking away material we add/or grow metal one particle at a time, in order to conform a piece of metal into a final product. It is therefore possible to "grow" material on a micro-scale accuracy. When requirements specify high tolerances, complexity, lightweight and miniature geometry, electroforming is a serious contender and in certain cases may be the only economically viable manufacturing process. The bottom–up approach is a wet chemical nanoparticle preparation process, which relies on building nanoparticles from the atom level of the metal, do not generally make solid objects. They make clusters, powders, or chips. The difficulty in consolidating nanostructured material is that sintering is time-consuming and at the sintering temperature, the structure coarsens. Since 2010 this process - HSTEF has been modified and developed by the author as a process for electrodepositing nanocrstalline metal/alloy micro sized components to synthesis of graphene, 40-80nm Ni/Co alloy nanowires and nano-rods without the need for electrodepositing into porous templates, a one-step process, at plating rates exceeding 1000 µm/per hour.

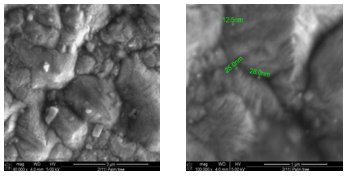

Fig.1. High-resolution SEM imaging of the surface of the nickel that was deposited by high-speed turbulent electrolyte flow plating, shows the particulate morphology, ranging from just-nucleated particles (less than 50nm) through to fully-grown grains which are micron-sized. The nickel forms a continuous dense structure, without any surface cracks, in spite of the use of a high current density during electrodeposition

Biography

Mohammad Hussain is a recognised authority on the synthesis of nanostructured surfaces by electrochemical techniques: ultra-high-speed electroforming/electrodeposition. He is the inventor of a process for depositing nanocrystalline nickel and its alloys directly on aluminium, titanium and stainless steel without any pre-treatment at a plating rate exceeding 700 µm/hour that are applied in metal finishing industry. Such coatings can provide higher wear and corrosion resistance compared to more conventional coatings. He has an established track record in initiating, growing and managing research groups in both university and industrial technology organisations.-

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