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Zaur Berishvili*, Marina Kipiani
LEPL Institute Optica, Tbilisi, Georgia

Development and research of an innovative magnetron ion-plasma electrodispersion reactor for the fields of catalysis, chemical engineering and technology

The work is dedicated to the development of an innovative construction of a magnetron ion-plasma electro dispersion reactor based on a planar-rotational magnetron sputtering device with improved capabilities in the direction of synthesizing catalysts, as well as general chemical engineering and technology, and its use in laboratory research.

For the synthesis of modern catalysts, the use of physical methods, in particular, the magnetron sputtering method, is very limited, since in the process of formation of nanoparticles on the coating, coagulation processes are observed and, as a result, a high probability of cluster formation, which prevents and makes it impossible to synthesize flat catalytic coatings on the entire surface of the samples. The magnetron sputtering method has certain advantages compared to chemical and other existing methods. The advantages of the innovative planar-rotational magnetron developed by us are as follows: it is compact; The flow of the cooling liquid not only provides effective cooling of the sputtering target and the cathode node as a whole but at the same time it is used for the rotation of the magnetic block; Has a high rate of use of target material; It is distinguished by a uniform erosion zone of the disk target; The stability of the plasma is ensured by the arrangement of permanent magnets along the involute circle in the rotating magnetic block and as a result, the creation of a closed magnetic field of a complex configuration; Are controllable technological parameters: the configuration of the magnetic field on the surface of the disk target, the frequency of rotation of the magnetic block and the distribution of the density of the discharge currents. We are introduced to the ion-plasma electro dispersion reactor created on the basis of the mentioned innovative, planar-rotational magnetron.

The method of forming nanomaterials in the process of sputtering the target material includes the formation of a flow of macro droplets in the active zone of erosion and their cascade division in the region of a toroidal shape magnetron plasma. The formation and electro dispersion of macro droplets occur under the action of intense ion bombardment between the inputs and outputs of the magnetic field lines in a closed circuit. The sputtered atoms and molecules of the target material freely pass through the toroidal shape plasma, and macro droplets from the target material in the plasma volume are recharged. Further, as a result of the development of the process of Rayleigh or capillary instability in plasma, they undergo cascade fission. The process of cooling and solidification of nanoparticles occurs outside the plasma region in the vacuum space between the target surface and the substrate holder. Due to the fact that the formed nanoparticles have the same charge, they are not attracted to each other and this eliminates the risk of increasing the size of nanoparticles due to maturation or agglomeration by Oswald. Rapid cooling of monodisperse nanoparticles formed in vacuum space and on the substrate, surface contributes to the save of their spherical shape, amorphous structure, and size of 2–4 nm. Obtaining a coating with an amorphous structure composed of individual spherical nanoparticles on the samples can be realized by maintaining the temperature of the

nanoparticles formed as a result of cascade decomposition at such a level that ensures the conditions for the formation of Van Der Waals or metallic bonds.

Biography

Dr. Zaur Berishvili studied physics at Tbilisi State University Iv. Javakhishvili and received a diploma in radio physics and electronics in 1966. In the same year, he began working at the Research Institute of Semiconductor Devices, as an engineer, then as a leading engineer. He then joined the research group of Prof. Svechnikov at the Institute of Semiconductors of the Academy of Sciences of the Ukrainian SSR. In 1984, he received his Ph.D. He has published over 40 scientific articles in SCI (E) journals.