

Influence of nitrogen content on microstructure and the mechanical properties of nanoscale CrAlN coatings

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The first generation binary coatings as TiN, CrN, ZrN, WN, among other, have been widely used for improving the wear resistance of cutting tools and various machinery parts. However, the increase in productivity in the manufacturing process requires tools and machines that can operate at much more severe working conditions, in which binary coatings no longer meet these requirements. An alternative is the use of ternary and quaternary coatings, which have higher hardness and wear resistance. In this work a coating of chromium aluminum nitride (CrAlN) with nanoscale structure and applied on H13 steel samples was development using the plasma assisted unbalanced magnetron sputtering technique and varying the nitrogen content between 22 and 41%. The influence of nitrogen content on the microstructure, composition and existing phases as well as on the mechanical and tribological properties of the coatings was evaluated. To this purpose scanning electron microscopy, energy dispersive X-ray spectroscopy, micro Raman spectroscopy, X-ray diffraction, atomic force microscopy and nanoindentation measurements were carried out. Wear resistance was measured by a tribometer using the ball-on-disc method. The sample coated with CrAlN and a nitrogen content of 16% showed the best mechanical and tribological properties whit increased wear resistance 4 times greater than the uncoated steel sample, which opens a potential application for cutting and forming tools, as well as for machine parts subjected to wear conditions.

Biography

Bejarano Gaitan Gilberto received his engineering degree in Metallurgy and Materials Science in 1992 at the Technical University of Aachen (RWTH-Aachen), Germany and has completed his Ph.D. at the age of 42 years from Universidad del Valle, Cali-Colombia. He made postdoctoral at the Dortmund University of Technology in Dortmund, Germany. He is an Associate Professor at the University of Antioquia from the year 2007, belongs to the Centre for Innovation, Research and Development of Materials CIDEMAT, and directs the research area for surface engineering and coatings.

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A novel enzyme-free amperometric sensor for hydrogen peroxide based on Nafion/exfoliated graphene oxide-Co₃O₄ nanocomposite

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Cobalt oxide-based materials have been widely used for electrocatalytic activity toward various compounds, such as hydroquinone and methanol. A novel and fascinating carbon material used as a new substitute for these materials is graphene, a single layer of carbon atoms in a closely packed honeycomb two-dimensional lattice, which has recently attracted much attention from both experimental and theoretical scientific communities. Here, electrochemical detection of H₂O₂ was investigated on a Nafion/exfoliated graphene oxide/Co₃O₄ nanocomposite (Nafion/EGO/Co₃O₄) coated glassy carbon electrode. The morphological characterization was examined by scanning electron microscopy, X-ray diffraction, and electrochemical impedance spectroscopy. The modified electrode showed well defined and stable redox couples signal in both alkaline and natural aqueous solutions with excellent electrocatalytic activity for oxidation of hydrogen peroxide. The detection limit was 0.3 μmol/L with a linearity of up to 4 orders of magnitude and a sensitivity of 560 μA mmol/L cm⁻². The response time of the electrode to achieve 95% of the steady-state current was recorded at 4 s. The ability of the sensor for routine analyses was demonstrated by the detection of H₂O₂ present in milk samples with appreciable recovery values. In addition, the Nafion/EGO/Co₃O₄-GCE showed good selectivity for H₂O₂ detection in the presence of ascorbic acid, uric acid, and glucose. The attractive analytical performances such as remarkable catalytic activity, good reproducibility, long term stability, and facile preparation method made this novel nanocomposite electrode promising for the development of effective H₂O₂ sensor.

Biography

Gita Amini has completed his M.Sc. at the age of 24 years from Isfahan University of Technology. She is the Director of Analytical Chemistry Lab, a premier Bio-Soft service organization.

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