Formation of composite coatings by electrochemical co-deposition of gold and carbon nanocapsules

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Composite coatings formed by electrolytic co-deposition of metal and inert, semiconductive, and conductive particles has received great attention due to improved mechanical and physicochemical properties of the resulting material, i.e. corrosion and wear resistance, and the variety of engineering applications (aerospace, sensors, automotive, electronics, memory devices, construction, energy, biomedical, etc.). Gold electrodeposition is widely used, however, lifetime of gold coatings is still a concern and the increase in durability of those gold coatings could be improved by incorporating solid particles into the metallic matrix. Carbon is one of the materials used for this purpose due to the combination of hydrophobicity and conductivity. In this work, carbon capsules are presented as a promising carbon material for the codeposition with gold from a colloidal galvanic bath on a nickel electrode to obtain gold/nanocapsules composite coatings. Spherical carbon nanocapsules were synthesized using a silica template. They were obtained with an average diameter of 550 nm and a porous shell with an average thickness of 90 nm. Incorporation of nanocapsules was confirmed by surface analysis and confocal microscopy. The influence of suspension preparation, nanocapsule concentration and stirring during the co-deposition was analysed. Nanocapsules strongly adhered on the surface and were coated by the gold matrix forming rounded clusters. The efficiency of the galvanostatic deposition increased in presence of nanocapsules due higher active area and metal growth on the carbon surfaces. The results establish a theoretical background for the codeposition of carbon nanocapsules acting as carriers of lubricants for the further development of smart coatings.

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