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Effect of Multi-Walled Carbon Nanotubes (MWCNTs) in Reducing the Corrosion Rate in Cr-MWCNTs Composite Coatings

Nawal Mohammed Dawood[a] Ayad Mohammed Nattah[b] and Talib Abdulameer Jasim[c]

College of Materials Engineering- Metallurgical Engineering department, Babylon University

[a]Mat.newal.mohammed@uobabylon.edu.iq , [b] ayad.natah@uobabylon.edu.iq

[c]talib.abdalameer@uobabylon.edu.iq

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Abstract. Carbon steel was coated with Cr-multi-walled carbon nanotube (MWCNTs) coatings via electrodeposition. In this article, the impact of a combination of MWCNTs into the chromium coating on the morphology of the coating surface and corrosion characteristics was inspected. The MWCNTs seem to be evenly distributed across the chromium layer, according to scanning electron microscopy (SEM). Electrochemical measurements were used to conduct corrosion tests on samples of MWCNTs– chromium composite coated and pure chromium coated samples in aqueous NaCl (3.5 wt.%). The outcomes demonstrated a considerable increase in the resistance of corrosion due to the inclusion of MWCNTs during the chromium deposition procedure. In addition, the mechanism of anti-corrosion of the composite coating is also presented.

Using an electrolyte bath containing various concentrations of dispersed MWCNTs (0.5, 1, and 1.5 g/l), crack-free and compact coating of Cr-MWCNT composite were electrodeposited on the substrates of the mild steel. The potentiodynamic polarization technique was used to examine the coatings corrosion performance subjected to a 3.5 weight percent of NaCl medium. When compared to chromium coating, the Cr-MWCNT composite coating showed the lowest corrosion rate ($1.045x10^{8}$ mpy) compared to chromium coating ($4.891x10^{8}$ mpy).

Introduction

One of the most crucial methods for creating composites with non-metallic and metallic elements is the electro-codeposition. For improved wear resistance, hardening, corrosion resistance, or dispersion hardening, the coatings are developed to comprise solid particles of carbide [1, 2], oxide [3], and diamond [4, 5]. For self-lubrication, polymers have been codeposited [6].

Since their discovery by Fisher et.al. [7], carbon nanotubes (CNTs) have sparked both fundamental and practical interest. A few micrometers long and with an order of a nanometer for the diameter, these nanotubes are simply rolled sheets of graphite with a half-fullerene cap on either end. The use of carbon nanotubes in nanodevices like nanodiodes and nano transistors as well as other significant applications has been made possible by their new electrical characteristics [8, 9]. The CNTs have also been discovered to be incredibly strong. By measuring the amplitude of the inherent thermal vibrations in the TEM of the isolated nanotube, Tans et al. [10] evaluated their Young's modulus and discovered that the average value was 1.8 TPa. The multi-walled nanotubes are the stiffest, according to Trealy et.al. [11], who utilized an atomic force microscope to analyze their mechanical characteristics. The fabrication of needle-like tips for atomic imaging devices has made use of these extraordinary mechanical capabilities.

The use of CNTs as reinforcing components in structural materials has recently received increasing attention [12]. There have been significant improvements, particularly in the preparation of CNTs/polymer composites using repeated stirring as mentioned by [13], high-energy sonication solution-evaporation mentioned by [14], and surfactant-assisted processing [15], and interfacial covalent functionalization [16]. However, relatively few studies have been conducted on the CNTs/metal composite. According to these researches, the mechanical parameters of the metal-based composite with CNTs implanted were much lower than expected and did not significantly increase

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