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Study of corrosion behaviour of Al2024 nanocomposite reinforced with MWCNTs

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ABSTRACT

In this research work, Multiwalled carbon nanotubes (MWCNTs) were reinforced with Al2024 alloy via powder metallurgy route. MWCNT taken in weight percentage of 1 %, 2 %, and 3 % were mixed in a planetary ball mill and then compacted for sintering followed by heat treatment. Sintered-heat treated nanocomposite was explored for corrosion behaviour by weight loss method and potentiodynamic polarisation (PDP) methods using 0.1 N HCl and 3.5 % NaCl at 25 °C for 20 h. Experimental results revealed that corrosion rate decreases by 55 % in weight loss method, whereas 30.8 % in PDP method mainly owing to the presence of MWCNT. Morphological, elemental study and uniform dispersion of the MWCNT reinforced Al2024 were analyzed using SEM, TEM, XRD, and EDS.

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1. Introduction

Aluminium is used as high strength, low density, anticorrosive, material. This has industrial applications in various fields of engineering such as automotive, marine, and storage applications. Aluminium has various mechanical, chemical, electrical and corrosion resistance properties [1–7] gave thought to researchers for developing this metal matrix composites for finding its suitability by varying different properties using mechanical operations such as ball milling, extruding, compacting, and heat-treatment processes. Aluminium is a versatile light-weight metal can be made to flow at molecular level which changes its properties when the load is applied. Changing of shape and structure influences material at crystalline structure level. Carbon nano-tube as reinforcing material has been used for changing its properties such as strengthening and chemical properties as corrosion. Using this, researchers over the globe studied both single-walled nanotube and multiwalled nanotube to evaluate its microstructural behaviour and reinforcing characteristics with other matrix materials. Reinforcing MWCNT in volume or weight percentage varying from 0.5 % to 5 % using suitable mechanical fabrication techniques [8,9] for the property enhancement has been carried out.

The research work on fabrication of MWCNT-Al2024 composite using powder metallurgy route has been rarely reported. Hence, the focus has been made on to reinforcement of MWCNT with Al2024 alloy using planetary ball milling, and compacting in split die for sintering and followed by sintering-heat treating. Secondly, corrosion behaviour was studied by weight loss and PDP method using 3.5 % NaCl and 0.1 N HCl solution in an ambient environment to check the potentiality of nanocomposite as structural materials [10]. Results of this work will help us to use this nanocomposite material to use in food, water storage and marine application devices.

2. Experimentation

2.1. Materials used

Al2024 alloy powder of 200 mesh size is presented in Table 1a. Physical and mechanical properties are listed in Table 1b.

Pristine Multiwalled CNTs in powdered form was procured from NANOSHELL, USA having purity of 98 %. Composition of Multiwalled CNT used is having density 1–2 g/cm^3; size 10–50 nm × 2–6 nm × 10–20 μm; melting point 3652–3697 °C.

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