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# Corrosion behavior of Multi walled carbon nano tubes reinforced Zirconium oxy chloride Composite coated over SS316 L in sodium chloride solution

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**ABSTRACT**

In this paper it is discussed about the coating of multi walled carbon nano tubes reinforced Zirconium oxy chloride composites over SS316 L plates for dental applications. Multi walled carbon nano tubes are reinforced in the solution of zirconium oxy chloride and made fine dry powder in ultra sonicator. This powder has been coated over SS 316L by spin coating method. In Electro chemical corrosion examination in the presence of sodium chloride electrolyte solution it is observed that coated samples possesses high corrosion resistance than the uncoated samples. The graph has been plotted between log current (A) with the Potential difference (V). Also the Scanning electron microscope images were performed for the multi walled carbon nano tubes reinforced Zirconium oxy chlorides.

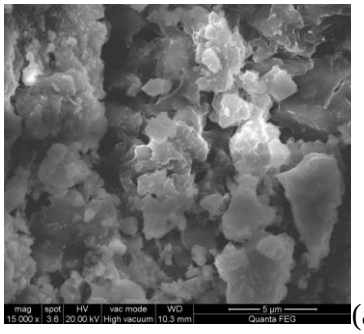
**KEYWORDS:** Multi walled carbon nano tubes; Zirconium oxy chloride; electrochemical corrosion; ultra sonicator; spin coating; Scanning electron microscope.

## 1. INTRODUCTION

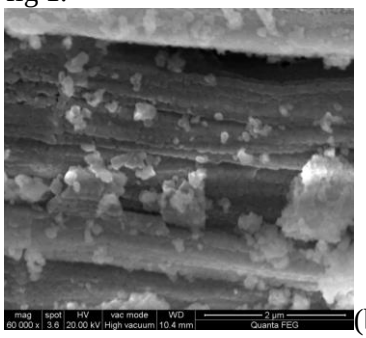
Multi walled carbon nano tubes possess excellent wear resistance and other mechanical properties which is 15 times greater and 5 times lighter in weight of stainless steel. Reinforcement of Multi Walled Carbon Nano tubes (MWCNT) over Zirconium oxy chlorides (ZrOCl2) can improve the wear resistance and corrosion resistance property. Materials such as SS316 L is a bio compatible material with less wear and corrosion resistance compared to the multi walled carbon nano tube reinforced ZrOCl2 composite. In this paper ultra sonification has been used for the reinforcement of MWCNT with Zr0cl2 to from a composite structure. This composite has been coated over the samples of SS316L through spin coating method which is discussed below. This coated samples were undergone the Electrochemical corrosion test to identify the corrosion resistance capability of the coatings with the uncoated samples.

## 2. EXPERIMENTAL WORK

**MWCNT Reinforced with Zirconium oxy chloride:** Initially $ZrOCl_2$ has been mixed with ethanol and De ionized water in the ration of 0.05:2.38:1.11 and stirred continuously with magnetic stirrer to obtain the clear solution of $ZrOCl_2$. MWCNT of 0.11g was added slowly in the solution containing $ZrOCl_2$ and sonicated using ultrasonicator. This process of Sonication has been extended for further 20 minutes and kept idle for another 30 minutes to settle down of the $ZrOCl_2$ + MWCNT mixture and aged for 24 hrs. Later this mixture became a powder and made to be harder by keeping in a hot oven for 24hrs. This sample has been taken for the heat treatment in a furnace at 800º C for 4 hours for the strong bonding between the $ZrOCl_2$ and MWCNT composites. The Scanning Electron Microscopy (SEM) images were taken before and after heat treatment as shown in fig 1.



(a)



(b)

**Fig.1.(a) SEM analysis before heat treatment (b) SEM after heating to 800º C**

Spin coating of $Zr0cl_2$ + MWCNT Composite over SS316L plates: The SS316 L surfaces have been cleaned with ethanol solution before the coating process and wipe off for the removal of impurities present in the substrate. An amount of $Zr0cl_2$ + MWCNT Composite sample has taken and mixed with polyvinyl pyrolidone (PVP) and ethanol with a molar ratio of 1.25:0.89:1.65.

**Fig.2.Ultra Sonicator (Spin coating)**

This solution has been taken in beaker and stirred completely to obtain milky white solution. $Zr0cl_2$ + MWCNT + polyvinyl pyrolidone solution has mounted in beaker as shown in fig 2 and the SS316 L sample has inserted in to this beaker. Because of the magnetic indentation in the instrument the solution present in the beaker has been coated over the substrate of SS316L. Finally the sample has treated to the room temperature to get dried.

**Electrochemical Corrosion of Coated samples:** The Electrochemical corrosion test has been carried out to identify the corrosion resistance capability of the coatings with uncoated samples. The Nacl solution has been taken with 3% of molar concentration and mixed with water of about 3/4 of volume to form an electrolyte. The sample has placed inside the electrolyte solution along with reference electrode and counter electrode. And uniform distance has been maintained among them.

## 3. RESULTS AND DISCUSSIONS

Electrochemical corrosion test was conducted for the $Zr0cl_2$ + MWCNT composite coated SS316 L. the results were plotted in graph of X axis with potential difference and Y axis with the Log current (A) as shown in fig 3.

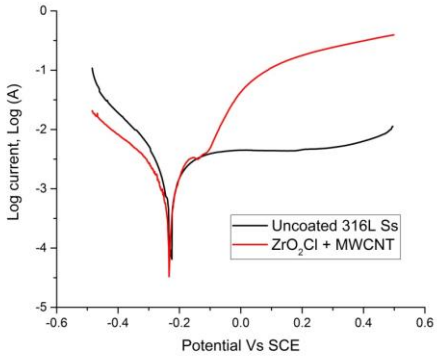



**Fig.3.Electrochemical corrosion graph**

It is observed that the coated samples possess corrosion resistance initially at the potential difference of -0.6 V to -0.2 V. But after that the corrosion resistance of the Zr0cl2 + MWCNT coated SS316 L samples have less corrosion resistance when compared to uncoated samples in the range of 0.2 V to 0.6 V of Potential difference. Because the coatings performed over the SS316L substrates were delaminating form the surface because of this potential difference in the electrolyte solution of Nacl. Interestingly the uncoated samples create less corrosion resistance in beginning and more in later part of the experiment.

## 4. CONCLUSIONS

Zr0cl2 + MWCNT composites were prepared and coated with SS316L substrates using spin coating method. During the electrochemical corrosion examination it is observed that the uncoated samples possess high corrosion resistance than the coated samples due to the delaminating of the coatings. This delaminating phenomenon happed may be because of the coating technology adopted or less thickness of the coating around 80 micro meters. It is expected that increasing in coating thickness may help in the achievement of the corrosion resistance when compared to the uncoated surface.

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