Synthesis of ascorbic acid doped silica polyaniline nanocomposite

[1]Gagandeep Singh Saimbi, [2]Dr. Dharampal Deepak, [3]Anupreet kaur, [4]Harpreet kaur
[1]Student, [2]Associate professor, [3]Assistant professor, [4]Student
[1]Department of Mechanical enginnering, Punjabi Univ. patiala,
[2]Department of Mechanical enginnering, Punjabi Univ. patiala,
[3]Basic and Applied Sciences Department,Punjabi Univ. patiala,
[4]Department of Electronics and Communication, Punjabi univ. patiala

Abstract - **Nanocomposites have been a topic of research for scholars now for quite a long time and still more research is required for their further understanding. In recent years, Polymer/Silica Nanocomposite's comparatively new category of Nanocomposites has attracted the interest of many scholars. This study encompasses the synthesis of Silica nanoparticles and Polyaniline(PANI)-Silica nanoparticles with ascorbic acid was done by using Sol-Gel Method. Ascorbic acid is added to the silica-PANI in different proportions and its effects are studied. Scanning Electron microscope (SEM) analysis is used to characterize and study of the structure and morphology of nanocomposite particles.**

keywords - **Conducting Polymers (CPs), Polyaniline (PANI), Silica nanocomposites, Ascorbic acid, SEM analysis**

I. INTRODUCTION

Nanotechnology is quickly far-reaching all vital fields of technology such as mechanical, aerospace, defense and medical. Scientists have discovered that properties of materials at larger dimensions differ from that of the same material at smaller dimensions. If we can understand these differences than there are a number of possibilities for improved applications and properties of devices and materials.

Conducting polymers can be used in new electronic devices (transistors, displays, sensors, energy-storage and memory cells), materials for shielding electromagnetic irradiation, polymer nanolithography, inhibition of corrosion, membrane constructing, catalysis and medicine. Miniaturization of devices, increasing their efficiency and lowering cost prices require development of new materials. The studies of polyaniline (PANI) and other conducting polymers (polyacetylene, polythiophene, polypyrrole, poly-p- (phenylenevinylene) have shown that they possess semiconducting properties. These polymers can exist in different oxidation states and, in common with inorganic semiconductors, respond to external influences by changing some characteristics (conductivity, color, density, magnetic properties, hydrophilicity or hydrophobicity, permeability to gases and liquids). Therefore, conducting polymers (which are sometimes called "smart polymers") may serve as an alternative to inorganic semiconductors (Trivedi, 1997). In 2000, the scientists who have discovered and studied conducting polymers were awarded Nobel Prize in chemistry. Due to its high stability and unique complex of properties, PANI was the first among conducting polymers to be used in practice as an antistatic coating, electrode material for batteries and condensers, as a corrosion inhibitor and detecting material for sensors. Polyaniline possesses controlled conductivity within the 10-10 – 101
$S \cdot cm^{-1}$ range combined with ionic and proton conductivity, redox activity, electro- and solvatochromism, non-linear optical properties and paramagnetism. In addition, the polymer is nontoxic, stable in aggressive chemical environments, has high thermal stability and low manufacturing cost.

In this study, we analysis the mechanical properties of Silica-Polyaniline with Ascorbic Acid. SEM revealed the formation of a protective film absorbed Ascorbic Acid on the Mild Steel Surface [1]. It investigates pitting inhibition with help of ascorbic acid by analysis the polarization effect in the presence of the inhibitor. The mechanisms of the inhibitor used to report the molecular properties and electrochemical properties of samples [2]. Quantum chemical calculations were used to confirm the ability of Ascorbic acid to absorb on a Mild Steel Surface. Through this, the molecule would increase the solubility of the inhibitors[3].

Conductive polymers make a big part of research going on in nanotechnology and its extending application in various fields. They are synthetic polymeric materials with high conductivity and good electrochemical activity. They offer good resistance against corrosion and also higher strength to weight ratio over metals [4]. The addition of an inhibitor is need to prevent corrosion effect to reduce the dissolution of metals within the acidic environment. The study of corrosion protection on mild steel has most interesting theoretical and practical concern. Due to its promising anticorrosion properties, they are used for anti-corrosion inhibitor for metals like copper, aluminum, steel and mild steel etc.[5]. Protective coatings of polyaniline are applied to mild steels to decrease the corrosion effect.

Silica nanoparticles are synthesized mostly using the Sol-gel method [6]. This method produces monodispersed particles and gives control over the size and morphology of particles. In Silica-polymer nanocomposites, silica nanoparticles are

commonly used fillers. In this paper, we study the synthesis and morphological effect of Nano-silica toward the preparation of nanocomposites [7,8].Composite materials plays an important role due to their lightweight and improved corrosion resistance. Silica is one of the common filler in composite materials [9]. The mechanism of adsorption has been reported by electrochemical and molecular mechanical properties. [2]

In the present work, PANI is synthesized using Aniline hydrochloride and Ammonium persulphate, followed by the addition of silica nanoparticles. This precipitate is then filtered and dried to achieve nanocomposite [10]. Unique properties of ascorbic acid and its applications in several fields have been analyzed by SEM analysis.

II. Preparation of Silica (SiO_2) :

Silica Nanoparticles have been a part of much scientific research due to its ease of preparation. Silica nanoparticles were prepared by using the Sol-gel technique[8].Silica particles are obtained by the hydrolysis method by liquid solution of Tetra-EthylOrtho silicate (TEOS) in the medium of methanol solution [4]. The ammonia reagents (2.5 to 3.5 mol L^{-1}), methanol (25 to 35 mol L^{-1}), HCl (0.05 to 0.14mol L^{-1}) and TEOS (0.015 to 0.15mol L^{-1}) is used and the size of particles has been analyzed by scanning electron microscope. The synthesized mixture is then stirred for 1.5 hours on a magnetic stirrer. Then mixture is kept for 24 hours at room temperature in an airtight environment. It becomes a white colored liquid and the mixture is filtered out using filter paper. The precipitate obtained is then dried and gives white-colored nanoparticles.

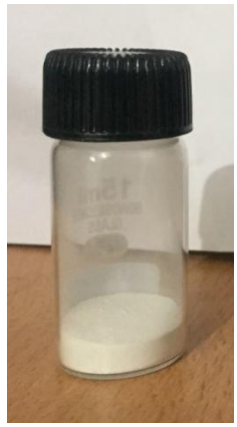

Figure 1: Silica Nanoparticles

III. Preparation of SiO_2 and PANI and Ascorbic acid:

The Silica-Polyaniline is synthesized by mixing Silica particles, Aniline and Copper Sulphate in the solvent which is methanol. The Aniline reagents (3.5 to 5 mol L^{-1}) , Methanol (35 to 45 mol L^{-1}) , Silica particles(15 to 30gm) and Copper sulfate (12gm) with Ascorbic acid were used. Two samples of nanoparticles containing different amounts of Ascorbic acid (400mg and 800mg) were synthesized separately [11]. The synthesized particles hence obtained are of size ranging between40-500nm. Both sample mixtures are then stirred for 1 hour on a magnetic stirrer and left at room temperature for 24 hours in an airtight environment. The mixture is then filtered by filter paper and after sometime dried, Mixture with 400mg Ascorbic acid gives dark-colored nanoparticles (Fig. 2) and the mixture containing 800mg Ascorbic acid gave nanoparticles with comparatively lighter green color (Fig. 3).

Figure 2: Silica-PANI nanoparticles with 400mg ascorbic acid

Figure 3: Silica-PANI nanoparticles with 800mg ascorbic acid

In Fig.2, the Silica-Polyaniline particles are interacted with 400mg of Ascorbic acid, and then it becomes dark brown colored nanoparticles.

In Fig.3, the Silica-Polyaniline particles are interacted with 800mg of Ascorbic acid, and then it formed lighter green colored nanoparticles.

IV. Results and Discussions

Synthesized nanoparticles are analyzed using Scanning Electron Microscopy (SEM). SEM is an electron microscope that uses a focused beam of electrons to produce a high-resolution, 3-D image of the surface of the sample.

Scanning Electron Microscopy

First of all, the samples were analyzed by Scanning Electron Microscopy (SEM) to check the size of particles. The analysis of SEM images shows that an increase in the concentration of ascorbic acid amends the size of nanoparticles. The increase in diameter of nanoparticles was observed with the increase in the ratio of Ascorbic acid. SEM analysis shows the structure of particles to be nearly spherical and size in nanometer.

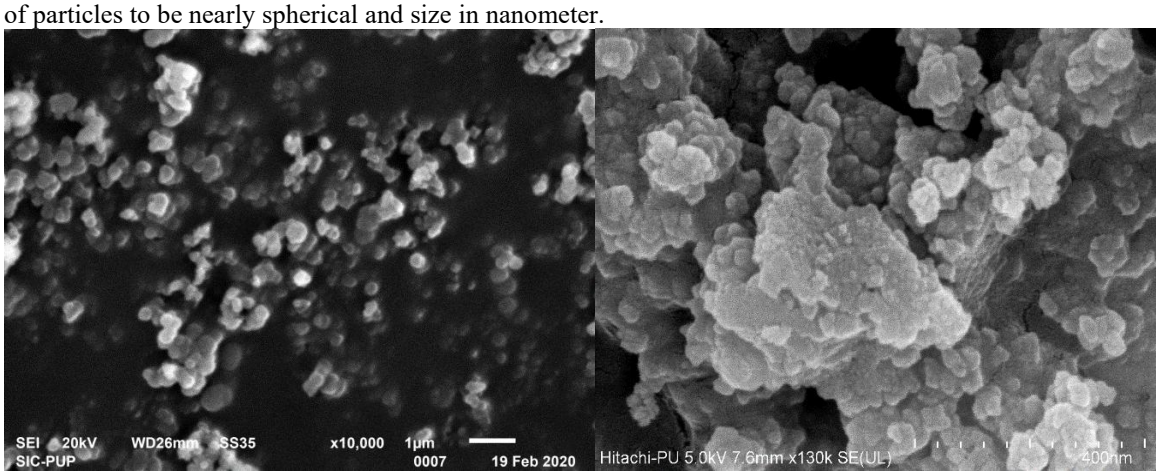

Figure 4: SEM image of the sample of SiO_2 Nanoparticles

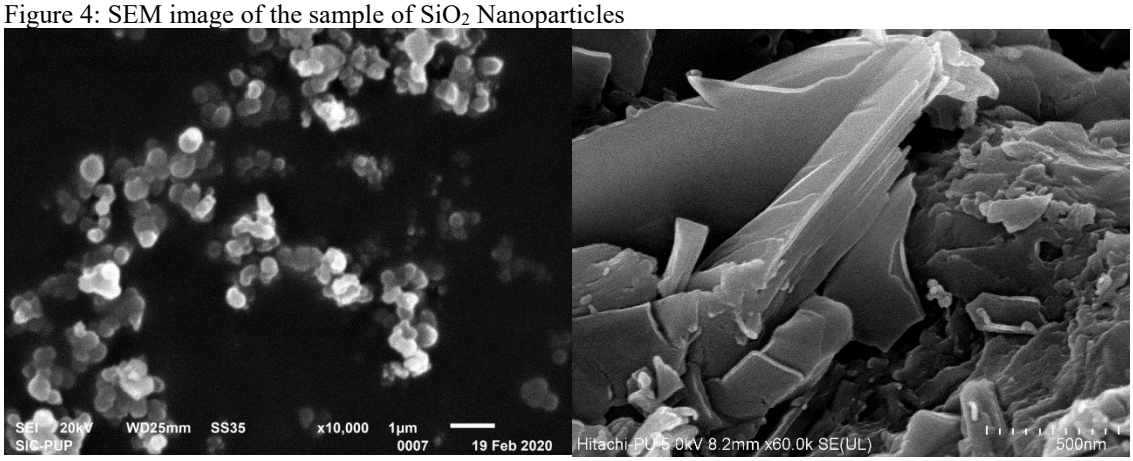

Figure 5: SEM image of the sample of SiO_2+PANI Nanoparticles + 400mg Ascorbic acid

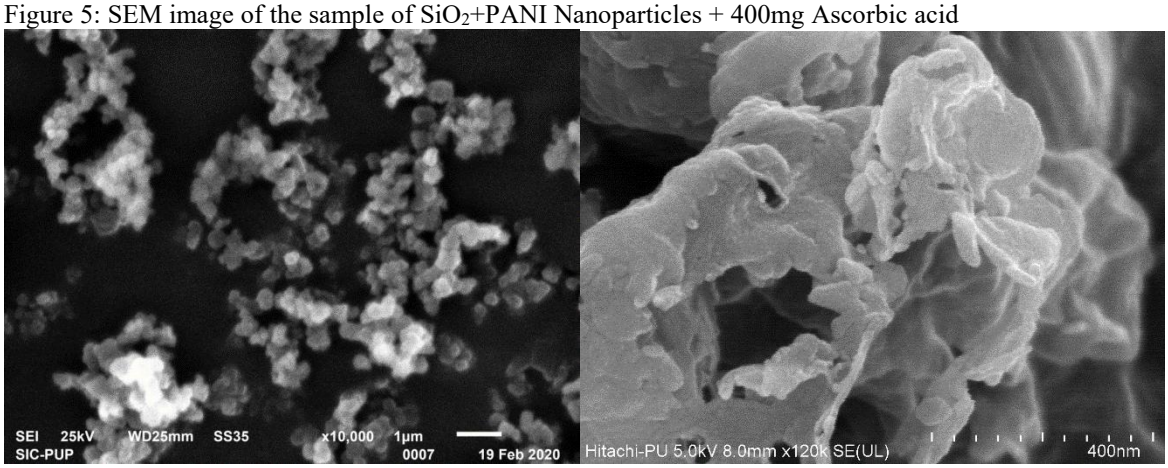

Figure 6: SEM image of the sample of SiO_2+PANI Nanoparticles + 800mg Ascorbic acid

V. CONCLUSION

An ideal inhibitor would be a compound preventing corrosion without unfavourable effects on the properties of concrete and also without environment hazards. Application of nanomaterial, such as ascorbic acid as environment friendly, low cost and corrosion protector of rebar corrosion would be applicable. Through this ascorbic acid proved as a good mild steel corrosion protector in acidic and in neutral media. The purpose of this experiment is to study the inhibitor action of ascorbic acid on the corrosion behavior of mild steel using NaCl solution. Owing to a wide spectrum of properties, polyaniline is used as a material for sensors and actuators, fuel cells, solar batteries, lithiumion batteries, supercapacitors, field effect transistors, and many other purposes. Various composite materials combining mechanical and physicochemical properties of the template and PANI (pH sensitivity, electron conductivity, various kinds of chromism, and the ability to absorb electromagnetic radiation in a wide wavelength range) may be applied in various fields of technology.

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VII. REFERENCES

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