ABSTRACT

Copper finds extensive use not only in electrical instruments but also exclusively in marine industries. Copper-Nickel (90/10) alloy also finds its use as anti-microbial actions, coolants, in ship – hulls, power plants and in heat exchangers. In Copper-Nickel alloy, nickel with 10 % and 30 % are most commonly used. Other compositions of Copper-Nickel alloys are also available as 0.05 – 0.4 % of manganese with 25 % of nickel and with 45 % of nickel as constantan. To protect such metals and alloy, various techniques had been applied so far including organic coatings and thin films. One such technique used is, corrosion protection using Self-Assembled Monolayers.

Here the present work deals with the formation and characterization of SAMs using green inhibitors such as azoles, amino acids and thiols. Copper of 99.9 % purity is used for the investigation of the work and also Copper-Nickel (90/10) alloy has been used for the studies.

Copper-Nickel (90/10) alloy has been investigated using 5-methyl-1, 3, 4-thiadiazole-2-thiol electrochemically in neutral medium of 300 ppm aqueous sodium chloride solution and copper has been investigated using aliphatic thiols - 5-methyl-1, 3, 4-thiadiazole-2-thiol, 5-amino-1, 3, 4-thiadiazole-2-thiol, 2-thiazoline-2-thiol, imidazoles such as 2-methyl-5-nitroimidazole, 2-mercapto-5-methyl thio-1, 3, 4-thiadiazole, Methimazole, 2-heptadecyl imidazole and amino acids of Azepane-1-carbo-dithioic acid and Carbocysteine in neutral media (100 – 300 ppm) using various analytical techniques and surface characterization studies such as Gravimetry, EIS, Polarization measurements, Cyclic voltammetry, Fourier-Infra Red Spectroscopic studies, Scanning Electron

Rectangular copper specimens of 3*1.5 cm with the thickness of 1 mm are used for gravimetry. SAMs covered copper (of same purity) and Copper-Nickel (90/10) alloy electrodes of 1*1 cm along with three electrode cell assembly are used. By Gravimetry the results are recorded for a period of 3 days immersion in 300 ppm aqueous sodium chloride solution after forming Self-Assembled Monolayers for a period of 1 day immersion in the inhibitor solution and also for a period of 10 days immersion in 300 ppm aqueous sodium chloride solution along with the inhibitor of concentrations 5 ppm to 30 ppm. The experiments are carried out initially, by nitric acid etching, polishing using emery sheets of 1 to 6 grades and finally by degreasing with acetone. Electrochemical studies (EIS, Potentiodynamic polarization, Cyclic voltammetry) are carried out after attaining a steady state potential, at least by half-an hour immersion in 300 ppm aqueous sodium chloride solution.

FT-IR, AFM, XPS and Water contact angle measurements are carried out for SAMs covered copper specimen and Electrochemical studies, Scanning Electron Microscopy/Energy Dispersive X-ray analysis and Gravimetric studies have been carried out for SAMs covered copper specimens in 300 ppm aqueous sodium chloride solution after a period of 3 days immersion.

Thus, from the results, it is decided the inhibitor of which lowest concentration has a higher inhibition efficiency, if the inhibitor behaves as cathodic, anodic or mixed type from potentiodynamic polarization studies and if it depends on the type of metal or alloy used, from the Niquist plots for electrochemical impedance studies. And the stability of SAMs from Cyclic voltammetric studies, the formation through Atomic Force
Microscopic studies and the chemisorptions of various elements through Energy Dispersive X-ray analysis, complex formations through X-ray Photoelectron Spectroscopic studies are decided. And among the inhibitors (thiols, azoles and amino acids), which provides the highest inhibition efficiency is discussed.