Activity Report

Visiting Prof. Amar Prasad Yadav (Tribhuvan University)

Effective Electropolymerization of Aniline onto Mild Steel for Corrosion Protection and Inhibition of Hydrogen Uptake

On the 27th of January, an on-line seminar was held online using Zoom and I presented a talk entitled "Selection of Electrolyte for Effective Electropolymerization of Aniline onto Mild Steel for Corrosion Protection" to the members of Akiyama Laboratory and Visiting Professor Sachiko Hiromoto (National Institute for Materials Science).

The subject of my talk was corrosion-resistant performance of polyaniline which has eco-friendly and non-toxic nature [1,2]. In my talk, selection criteria for effective electropolymerization of aniline onto mild steel and the tailoring of polyaniline film by rare earth metal ions (La and Ce) were discussed with regard to coating formation, its stability, and corrosion inhibition effect, focusing on three electrolytes, namely oxalic acid, sodium potassium tartrate, and benzoic acid in the alcohol-water (BAW) medium (Fig. 1). A host of instrumental tools as Fourier-transform infrared spectroscopy, ultraviolet-visible spectroscopy, scanning electron microscope in combination with energy dispersion spectrometer, transmission electron microscopy, and X-ray diffraction used to characterize the polyaniline coating were also discussed.

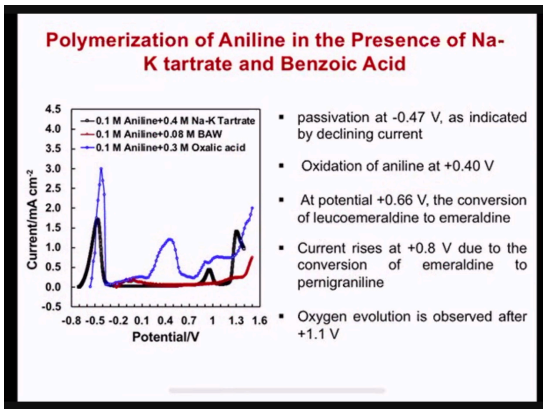
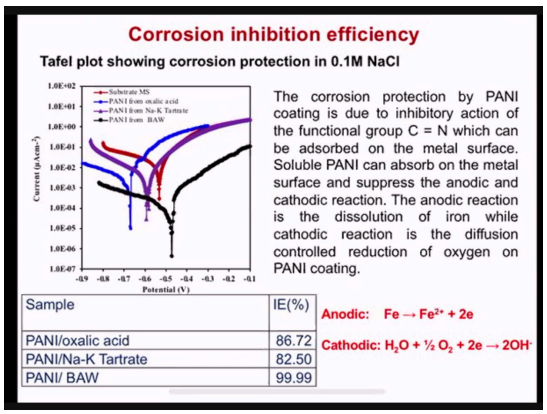


Fig. 1 Polymerization of Aniline in the presence of Na-K tartrate and benzoic acid and their effect on passivation behavior of mild steel.

The Akiyama laboratory members and I discussed about the presented subject, for instance the effect of dissolved ferrous ions from the substrate mild steel on the nature of the polyaniline coating, the difference in the property of polyaniline based on the polymerization procedure and so on.

After the seminar, the plan of the corroborative study was discussed. Since the polyaniline is effective for corrosion resistance and it shifts the open circuit potential to the positive direction, it is expected that hydrogen uptake to the substrate steel can be suppressed. Furthermore, due to the conductive property of the polymer, it is presumed that the polymer acts as the cathodic site and even when reduction reaction of proton takes place on the polymer, formed atomic hydrogen will not diffuse to the substrate steel and this effect is also expected to retard the hydrogen uptake. Consequently, polyaniline has the potential to avoid hydrogen embrittlement of high strength steels used under corrosive environments. In the future corroborative study, polyaniline will be applied on high strength steels prepared by using the optimized procedure established in my group, and its effect on inhibition of hydrogen uptake will be studied by using electrochemical techniques and thermal desorption spectroscopy.



Sample	IE(%)
PANI/oxalic acid	86.72
PANI/Na-K Tartrate	82.50
PANI/ BAW	99.99

Fig. 2 Corrosion inhibition efficiency of polyaniline.

References

[1] N.B. Devkota, S. Neupane, D.K. Gupta, U. Chaudhary and A.P. Yadav, J. Nep. Chem. Soc., 34, 72-80 (2016).

[2] N.B. Devkota, S. Singh, S. Neupane, D. K. Gupta and A.P. Yadav, J. Nep. Chem. Soc., 35, 94-103 (2016).