Modified corrosion protection coatings for Concrete tower of Transmission line

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Abstract. By adding nano SiO2 particles, an enhanced K-PRTV anti-pollution flashover coating had been prepared. Optical profile meter (GT-K), atomic force microscopy (AFM) and infrared spectrometer (FT-IR) characterization were carried out on the coating surface analysis. With the use of modified epoxy resin as the base material, the supplemented by phosphate as a corrosion stabilizer, to achieve a corrosion of steel and galvanized steel with rust coating. Paint with excellent adhesion, more than 10MPa (1), resistant to neutral salt spray 1000h does not appear rust point. At the same time coating a large amount of ultra-fine zinc powder can be added for the tower galvanized layer zinc repair function, while the paint in the zinc powder for the tower to provide sacrificial anode protection, to achieve self-repair function of the coating. Compared to the market with a significant reduction in the cost of rust paint, enhance the anti-corrosion properties.

1. Introduction

The corrosion resistance of existing power transmission tower, maintain taken to remove the original anti-corrosion spray paint anticorrosion coating or galvanized layer. And cold galvanized anti-corrosion processing again. Cold galvanizing due to poor adhesion easily fall off, at the same time, coating paint. Fast and convenient for construction, so much attention. The anticorrosive coatings in use against rust iron tower protection primer multi-select. With epoxy zinc-rich primer and anti-rust primer, a lot of coating on the surface show low surface energy because of the zinc layer. Poor adhesion, directly affect the protective effect of coating system, using coated paint to repair, after 2 ~ 3 years. Requires besmear again.

Foreign countries have a multi-functional coating with rust, such as Japan has developed a coating with oil on the surface of the coating of steel, from bisphenol A epoxy, polyamine - amide polysulfide, iron oxide red, Aluminum silicate and other components; another kind of underwater curing chemical resistance with oil belt rust bridge structure with the paint. The use of crude diphenyl methane isocyanate made of polyurethane prepolymer, moisture curing, and mixed with mica iron oxide, iron oxide red and so made of durable rust coating. The United States G.E Chemicals inc has developed a modified degrading agent, the rust inhibitor, which removes grease, rust and salt deposits, without the need for rusting or sanding the rusty surface to coat the material. Japan's Coatings Co., Ltd. ONIVAN series of primer is a special epoxy resin coating, rust conversion and rust coating type, not only on the substrate surface treatment requirements to reduce the SISSt2 level, and can be coated on a variety of old coating. Lichtenstein also reported a low-surface treatment coating that can be applied to oil-filled surfaces.

China's relatively low-surface coatings on foreign research is lagging behind. Some of the solvent-based coatings have been studied more mature. Such as the Navy Paint Analysis and Testing Center with epoxy resin E601 as the main component of the "H2000 with wet with rust 5 primer"; Shenyang Institute of Technology to determine the tannic acid and phosphate system as a conversion agent to modify the epoxy Resin for the film with the rust coating technology formula; Hunan Institute of Engineering to modified epoxy resin as the main film, phosphoric acid and tannic acid and a small amount of potassium ferrocyanide as a conversion agent with water with rust paint, with raw materials Easy to get, the production process is simple, rust effect is good. But the use of organic matter as a solvent or dispersion medium oily rust coating, because the pollution of the environment, energy consumption, unsafe and not be optimistic. Water-based paint in painting and application has a great advantage, not only conducive to the environment, but also save the organic material resources, so the development of more rapid.

2. Experimental details

2.1. Materials

Figure 1. The steel matrix

According to the information survey, select E44 as the epoxy resin base material. Other raw materials for the coating test include zinc phosphate, sodium dihydrogen phosphate, aluminum tripolyphosphate, zinc chrome yellow, xylene, acetone, alcohol, butyl acetate, n-butanol, 500 mesh zinc powder, silane coupling agent, curing agent (T31, polyamide 650, ZY-2015C). Among them, zinc chrome yellow, silane coupling agent as an additive is mainly to improve the adhesion of the coating on the zinc surface.

2.2. Characterization

Coating strength test using the United States PosiTest AT-M pull-coating coating adhesion tester and BYKPE-5126 paint film grid device. Neutral salt spray test using the British C & W salt spray corrosion test chamber SF-MP450, in accordance with GBT 1771-2007 "paint and varnish resistance neutral salt spray performance determination." Sample tilt angle of 20 °, salt spray deposition volume of 80cm2 collection area of 1.4ml / h.

The morphology of steel wires was examined by using Scanning Electron Microscope (SEM) Optical profile meter, atomic force microscopy (AFM). The IR analysis was carried out using a Fourier infrared tester in room temperature. Those tests were replicated about 3-5 times. Electrochemical test selection PARSTAT 2273 electrochemical work station. Experimental using the traditional three-electrode system, the working electrode for the coating sample, the reference electrode for the saturated calomel electrode, platinum as the auxiliary electrode.

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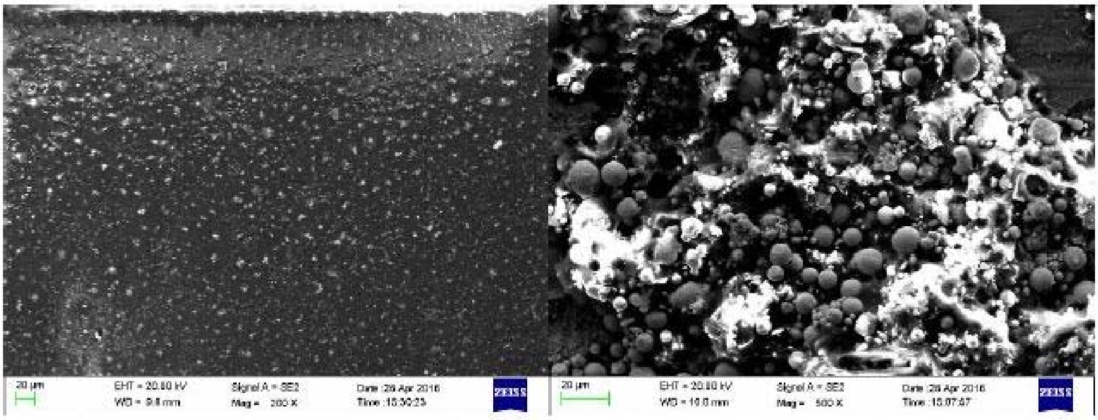
3. Results and Discussion

3.1. Morphology analysis of Modified rust corrosion protection coatings

Polyamide 650 prepared by the coating is more smooth, strong sense of resin. In the preparation of the coating process found that if the coating is too thin below 100μm, you can not form a complete, uniform coating.

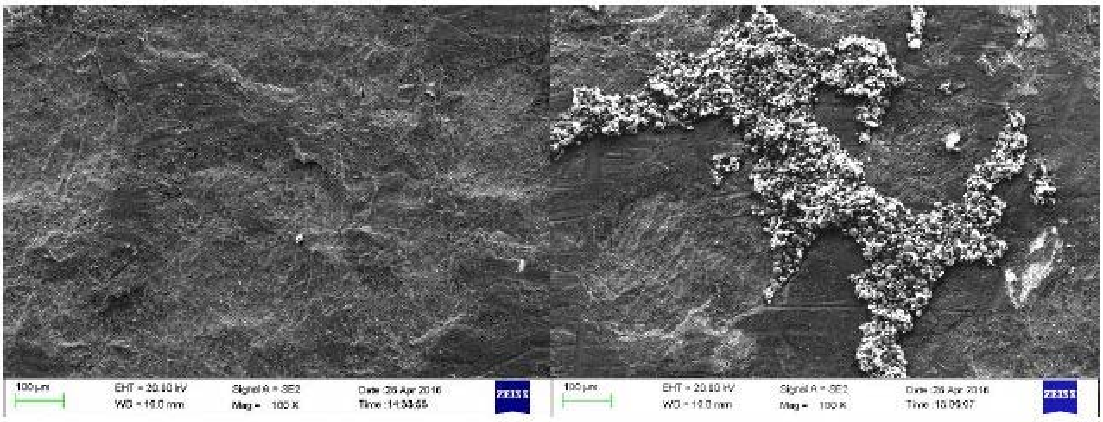


(a) (b)

Figure 2. Surface morphology (a) and cross-sectional morphology (b) of corroded steel

Fig.1 (a) for the coating surface morphology, we can see that the coating morphology is more uniform. (b) in the circular particles for the zinc powder, combined with (a) can be seen more uniform distribution of zinc powder in the paint. In a certain range to achieve the zinc powder interconnection, but also shows that the coating has a certain cathodic protection

The substrate surface there is a certain amount of resin and iron oxide, indicating that the coating can be a good way to infiltrate the corrosion of the surface, the morphology also shows that the fracture is very dense, to prove that the coating and the corrosion of good surface bonding.



(a) (b)

Figure 3. Surface morphology (a) and cross-sectional morphology (b) of corroded steel

From Fig.2 (a) and (b) can be seen, the section is relatively dense. The binding energy spectrum shows that the non-coating site is mainly broken at the base oxide layer. The fracture morphology also indicates that the coating fracture is broken in the dense oxide layer.

3.2. Binding force test of Modified rust corrosion protection coatings

Friction and Wear Results of Modified Coating Systems, it can be seen that the friction coefficient of the composite coating is 0.132, and both the acoustic emission and the COF show signs of wear. The results show that the wear depth is 78.1μm, the width is 1426.7μm, and the wear rate is 0.12μm / s.

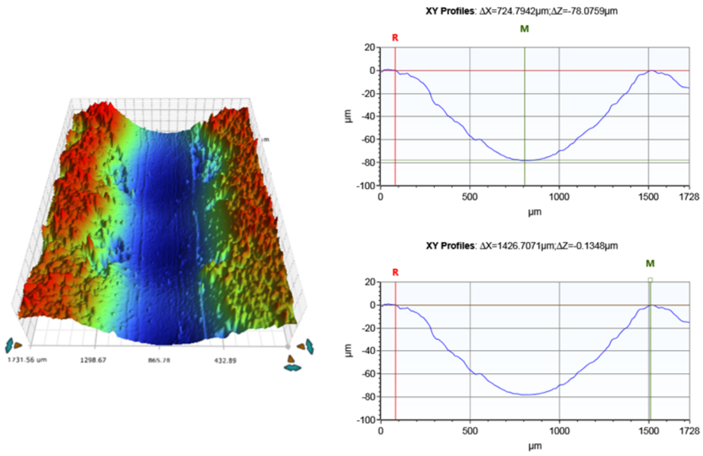


Figure 4. Composite coating friction and wear results.

The wear and the coefficient of friction of the composite coating system. It can be seen that the friction coefficient of the composite coating is 0.143, and both the acoustic emission and the COF show signs of wear. The results show that the wear depth is 60.9μm, the width is 1188.5μm, and the wear rate is 0.10μm / s.

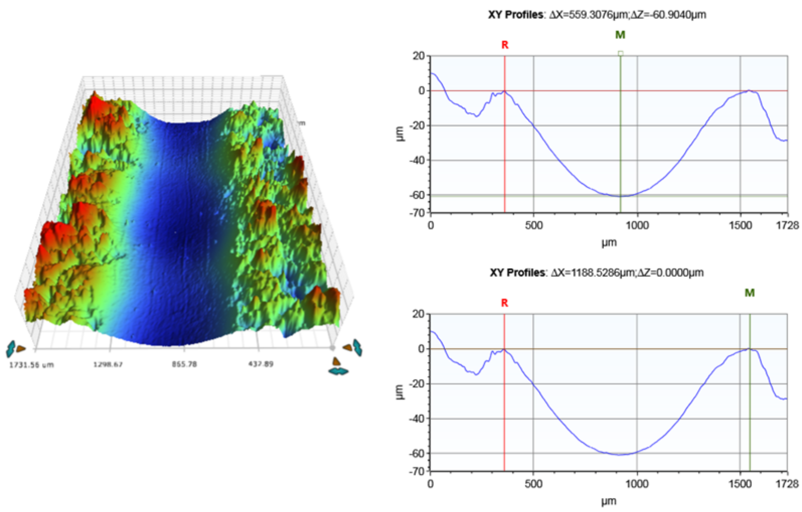


Figure 5. Composite coating friction and wear results.

Comparison of Friction and Wear Properties of Different Coatings. It can be seen that the modified epoxy and polyurea coating has a good friction reduction, the coefficient of friction is much lower than the galvanized layer. From the wear resistance point of view, modified epoxy and polyurea coating wear time is much higher than the ordinary coating, modified epoxy wear rate is lower than the galvanized layer. This shows that modified epoxy friction and wear performance is better than ordinary coating.

3.3. Electrochemical test of coatings

The modified coating was immersed in 3.5% NaCl and subjected to EIS measurements at 1, 6, 10 and 30 days. The measurement frequency was 100 kHz to 10 mHz and the AC excitation signal was 10 mV. The results are shown in Figure 6.

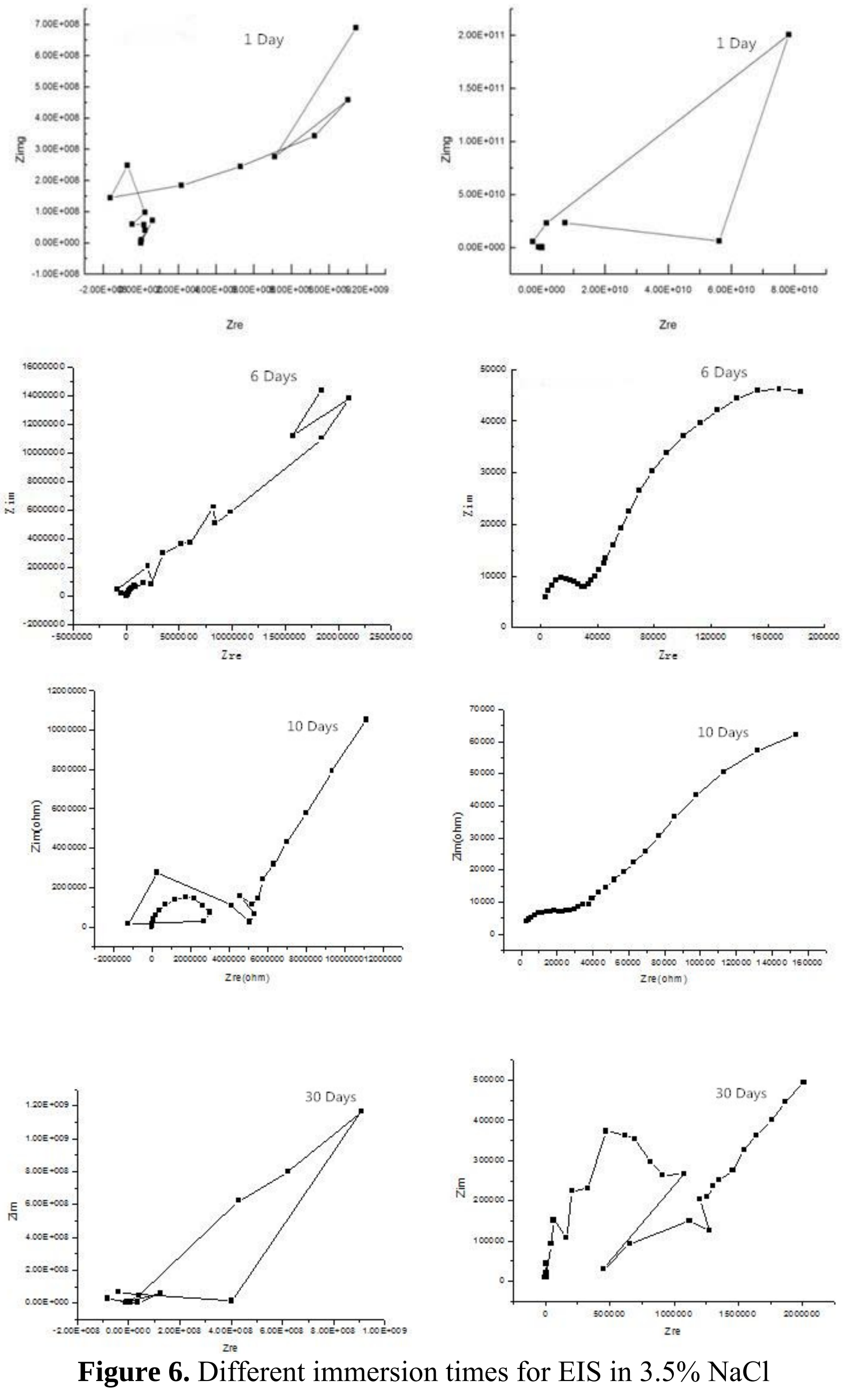


Figure 6. Different immersion times for EIS in 3.5% NaCl

The equivalent circuit model corresponding to the impedance spectrum of the soaking period can be given by Fig. In the figure, Rs is the solution resistance, Cc is the coating capacitance, and Rc is the coating resistance. From the AC impedance curve fitting results, soaking 1 day and 30 days, the coating resistance and capacitance changes greatly. It is generally believed that when the coating resistance | Z | is less than 106 Ωcm2, the metal corrosion under the coating has begun, indicating that the coating has failed. The electrochemical impedance values of the coatings were more than 106Ωcm2 after 30 days of immersion with samples of samples 2 and 3, which indicated that the coating could effectively prevent metal corrosion.

4. Conclusion

In this work, an enhanced K-PRTV anti-pollution flashover coating had been prepared by adding nano SiO2 particles. The experiment results have been use to optimize the further design and platform of the enhanced K-PRTV pollution flash coating experiment. K-PRTV has the higher rough durability and greater contact angle which is based on the modification effect of nano SiO2 particles. More importantly, the K-PRTV coating with super hydrophobic modified has an improved significance for anti-pollution flashover coating.

Acknowledgments

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