Influence of SPTFE on the Corrosion Behavior of Composite Coatings during Salt-Spray Test

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In order to provide protection against long-term corrosion, aluminum parts are coated with various protection methods: anodizing, painting, and others. Another modern method of corrosion protection is plasma electrolytic oxidation (PEO) [1]. There are also theories that combining some protection methods into a single composite coating can improve properties. One such composite coating is the combination of a paint applied to a PEO-coating. This paper presents a study of electrochemical properties and corrosion resistance of a composite coating obtained by spray painting of the PEO coated sample using the paint with the addition of different concentrations of superdispersed polytetrafluoroethylene (SPTFE) [2, 3].

In this work, a multicomponent electrolyte was used to form the PEO coating as a protective sublayer.

On the formed PEO coating, 5 types of paint and varnish solutions were applied by spraying. Jotun SeaForce 30 was chosen for modification. SPTFE was added to this paint in different concentrations from 0 to 20 mass. % of the total solution. The resulting coatings are shown in Figure 1.

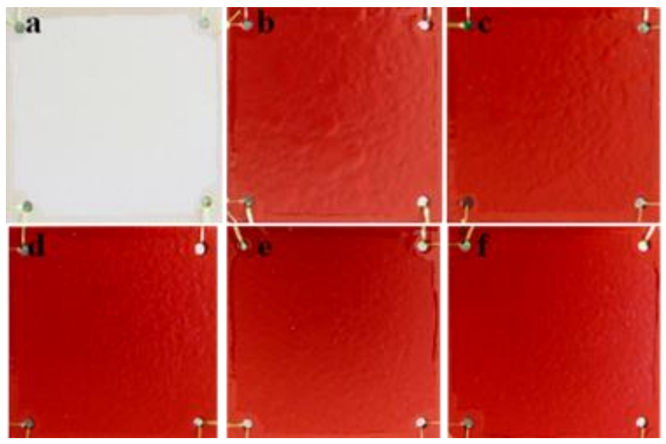

Fig. 1. Formed protective coatings: a - PEO coating, b - CC without SPTFE, c - CC with 5 % SPTFE, d - CC with 10 % SPTFE, e - CC with 15 % SPTFE, f - CC with 20 % SPTFE.

Together with electrochemical studies of CC salt spray tests were carried out in a salt spray chamber to assess the protective properties of composite coatings under identical operating conditions. The following spray mode was used: 5 % NaCl solution was sprayed for 15 min every 45 min of exposure. The temperature was kept within 27±2°C. The duration of the test is 10 days with an interim analysis every 4 days of the exposition. After the end of the test all samples were weighed to calculate the weight loss.

The application of a paint coating on a PEO coating led toan increase in the coating thickness up to 120±12 μm. An additional dependence of the coating thickness on the content of SPTFE in the paint was obtained with the same method and number of application layers: an increase in the concentration of SPTFE leads to a slight decrease in the thickness of the composite coating.

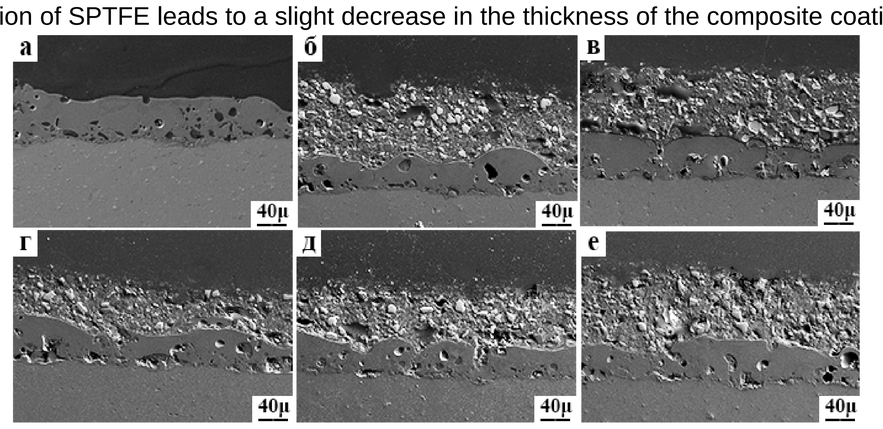

Fig.1 Morphology of thin sections of the studied coatings: a - PEO coating, b - CC without SPTFE, c - CC with 5 % SPTFE, d - CC with 10 % SPTFE, e - CC with 15 % SPTFE, f - CC with 20 % SPTFE.

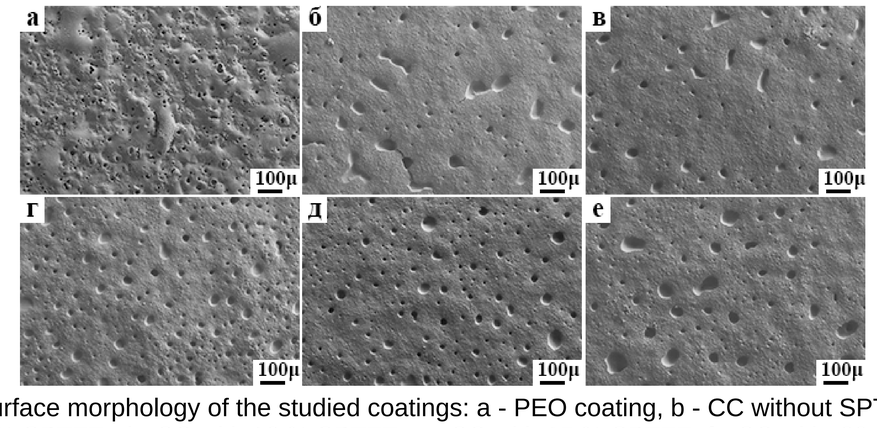

Fig.2 Surface morphology of the studied coatings: a - PEO coating, b - CC without SPTFE, c - CC with 5 % SPTFE, d - CC with 10 % SPTFE, e - CC with 15 % SPTFE, f - CC with 20 % SPTFE.

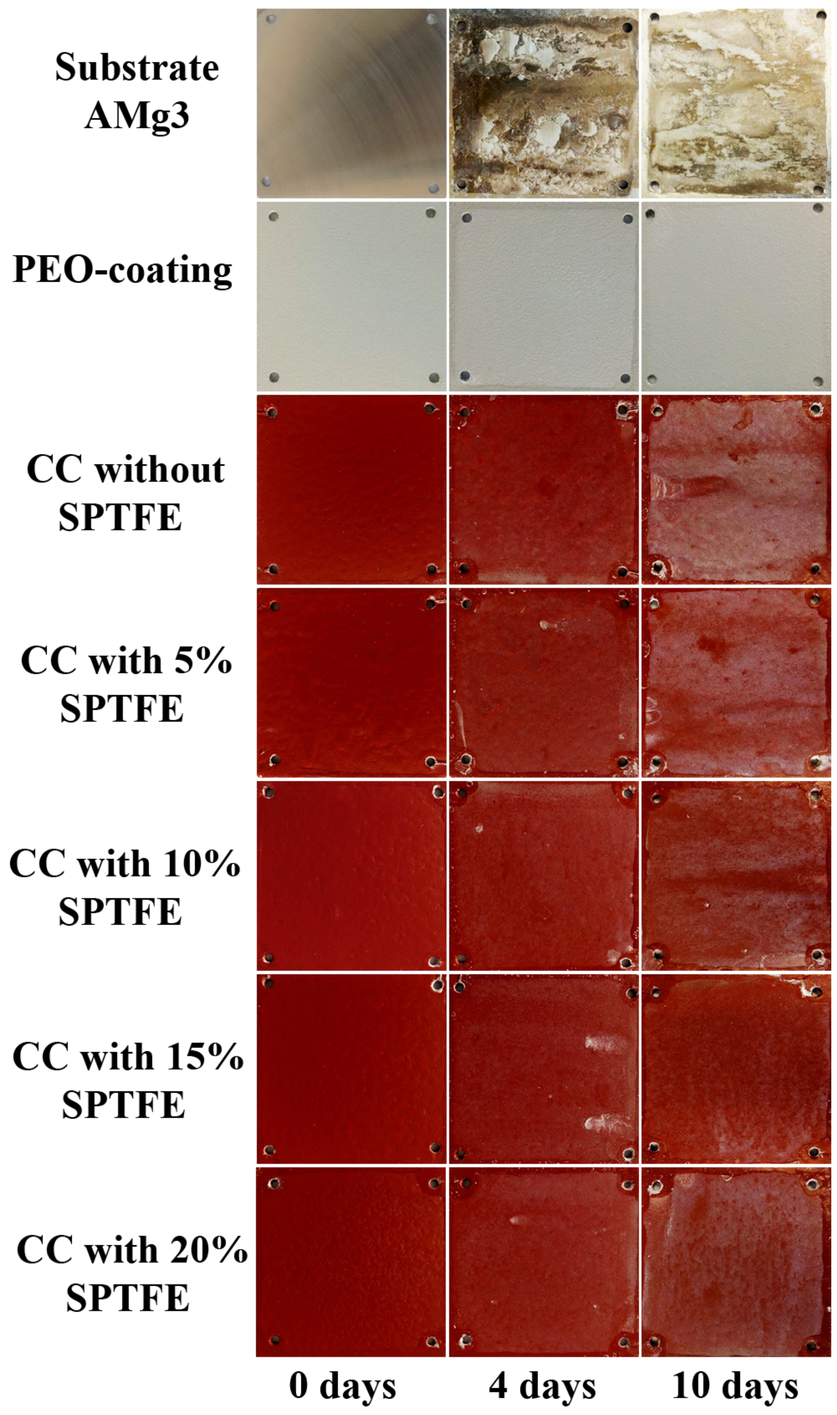

Fig. 3 Appearance of the studied coatings before testing in SFC, after 4 days and after 10 days of testing in SFC

Analyzis of the samples after the salt spray test led to conclusion that all composite coatings passed the test and do not have any defects on the surface. In turn, an oxide film appeared on the aluminum alloy, and the PEO coating darkens with increasing testing time, which indicates internal oxidation due to the porosity of this coating.

After the samples were rinsed with deionized water and air dried for 120 min, they were reweighed. The mass measurement before and after the salt spray test showed that bare aluminum alloy and PEO-coated samples increased their mass due to oxidation by 0.14 % and 0.07 %, respectively. Composite coatings behaved differently in this experiment: all coatings lose mass. It should be noted that the addition of 10 % SPTFE resulted in the smallest weight loss of 0.04 %. For composite coatings without addition and with 5 % SPTFE, the weight change was the same - 0.05%. And an increase in the concentration of SPTFE to 15 and 20 % leads to an increase in weight loss to 0.07 and 0.11 %, respectively. From the obtained data on weight loss, it follows that the optimal value of the concentration of SPTFE is 10 %, and a further increase leads to a change in the properties of the composite coating.

A PEO coating has been developed that can serve as a substitute for a primer layer for the formation of composite coatings by applying a paint coating on PEO layers. The formed composite coatings were tested, according to standards, in a salt spray chamber. As a result of the study the optimum concentration of superdispersed polytetrafluoroethylene to a paint was determined and equal to 10 %. The lower concentration value leads to minor changes relative to the original paint. An increase in concentration of more than 10 % leads to a deterioration in the properties of the composite coating.

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