Nanostructured catalytic cobalt containing PEO-coatings on alloy AL25

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One of the perspective ways to improve the performance of internal combustion engines (ICE), such as the incomplete combustion of fuel and formation of toxic components (CO, NO_x), can be the use of catalysis *in situ* in the combustion chamber. Catalytic processes are characterized by lower temperatures of the fuel burning start as well as its higher completeness. It seems appropriate to deposit a catalytic layer directly on the surface of ICE pistons manufactured of AL25 complex alloyed silumins. At high temperatures, significant advantages are shown by a family of catalysts based on cobalt oxides which are formed on the surface of silumins by plasma electrolytic oxidation (PEO) providing the incorporation of active components into an alumina matrix. The aim of this study is to substantiate the electrolyte composition and the PEO modes for the formation of a mixed oxide layer with high cobalt content on the surface of the AL25 alloy.

The PEO of samples with surface of 2 cm^2 was conducted using a B5-50 stabilized power supply in an electrolytic cell under conditions of forced cooling of the electrolyte to a temperature of 20–30°C at a varied current density *i* in a range of 2,0–10 A/dm^2. PEO was implemented from working electrolytes composition, g/l: $K_4P_2O_7$ – 66–297; $CoSO_4$ – 7.5–46.5.

It was shown that in the program PEO mode in indicated electrolyte dense ceramic nanostructured coatings with high adhesion to the substrate can be obtained on the surface of AL25 alloy. The composition of the electrolyte, the starting current density and both sparking and final voltage strongly affect the oxidation process and composition and relief of coatings surface. It was established that the mechanism of AL25 alloy oxidation in cobalt-pyrophosphate electrolytes significantly different from PEO in alkaline permanganate solution [1]. Formed mixed oxide coatings have developed surface with Co content up to 30 wt. % (in terms of metal). The composition and morphology of the surface causes high catalytic properties of synthesized materials, which confirmed the results of testing in model CO oxidation reaction, neutralization of NO_x, and fuel combustion for various modes of engine operation.

1. N.D. Sakhnenko, M.V. Ved', D.S. Androshchuk, S.A. Korniy, Surface Engineering and Applied Electrochemistry, **52** (2016) 145.