SUMMARY

The corrosion of various surface treatments on aluminum and its alloy AA2024-T3 or alloy AA7075-T6 was studied in NaCl solution or in Harrison's solution.

Corrosion properties were improved by the addition of cerium(III) acetate, $Ce(Ac)_3$, or cerium(III) chloride, $CeCl_3$, between 1 mmol and 5 mmole in the corrosive medium. Effective protection was also obtained with the formation of CeCCs of 0.05 M $CeCl_3$ or cerium(III) nitrate, $Ce(NO_3)_3$, with 0.25 mol hydrogen peroxide, H_2O_2.

Then, the optimization of the synthesis with different molar ratios 3-methacryloxypropyltrimethoxysilane - MAPTMS/tetraethylorthosilicate - TEOS = (9; 2.3; 1; 0.42 or 0.11) with an excess of H_2O (H_2O/Si = 5), catalyzed by hydrochloric acid - HCl (H_2O/HCl = $1/9.6 \times 10^{-4}$) at 60 °C was studied. The inhibition efficiency IE for aluminium was more than 99.3 %. Disadvantages of such coatings are the synthesis temperature, the necessary dilution the sol with ethanol and drying the coating composition at 150 °C.

In the following, the synthesis was optimized at room temperature. Coating protects the aluminum well, but it is not effective for AA7075-T6. To improve the corrosion properties, the coating was dopped with the mass fraction $w = 0.5$ % nanoparticles of cerium/zirconium oxide, CeO_2/ZrO_2, but the addition had a negative effect on the corrosion properties of the coating.

Then the sols was synthesized with a smaller amount of H_2O (H_2O/Si = 1.76) and HCl (H_2O/HCl = $1/4.8 \times 10^{-4}$) which was not diluted with ethanol. Drying takes place at 180 °C. Protection is not efficient enough for AA7075-T6. Properties of Sol 1 was improved with the addition of separately synthesized a zirconium sol from zirconium tetrapropoxide – ZTP (Si/CTP = (19.7; 9.8 or 2.46)), chelated with methacylic acid - MAK (CTP/MAK = (0.5; 1 or 4)). The coatings were dried already at 100 °C and protect the alloy significantly better. By optimizing, the properties of the coating are markedly affected by aging the sol for 48 h and drying in the presence of daylight. The influence of different ratios Si/MAA = 2.45 or 1.23 in the Si/CTP = 2.46 was also studied and was found that the corrosion properties were further improved. The coating with Si/MAA = 1.23 or less, had been dried at room temperature. Coatings according to the corrosion characteristics can be compared with a chromate protection. The best corrosion properties (the highest linear polarization R_p and the lowest corrosion current density j_{corr}) had the coating with Si/CTP = 1.23 and CTP/MAK = 0.5.

Corrosion properties were improved by doping the coating with cerium salts. In particular, $w(Ce(NO_3)_3) = 0.5$ % improved the coating properties and effect on the coating network. Such a coating may have the ability to self-healing.

Keywords: aluminum and aluminum alloys, corrosion, cerium salts, hybrid sol-gel