

Production of oxide coatings to improve the surface properties

T.N. Patrusheva, N.Yu. Snezhko, V.A. Fedyaev

Siberian Federal University, 660074, pr. Svobodny, 79, Krasnoyarsk, Russia
pat55@mail.ru

The surface appearance and durability and storage stability provide coatings including oxide materials, which are the most stable form of matter. The oxide films can perform various functions, such as anti-static, waterproof, anti-corrosion, thermal barrier, energy saving, anti-fouling, self-cleaning. For protection against UV rays TiO_2 coating is most effective [1]. Under the influence of the ultraviolet component of sunlight such coatings are promoted the decomposition of organic contaminants on the surface of the glass and giving it the hydrophilic properties, whereby pollution and their decomposition products can be easily removed from the surface and self-cleaned, for example, by rain [2].

Boats and ships below the water line have the antifouling paint coating against plant and living organisms. The compounds slowly releasing tributyltin are effective, but they are harmful to the coastal water and the living world. Coating which release copper ions are harmful also. In this connection it is of interest to study new antifouling coatings, particularly TiO_2 [3].

Modern multi-functional coating is produced by vacuum deposition (ion bombardment of the surface in a vacuum). Its application is exclude the peeling of layers applied at temperature variation when the film are stretched or compressed. [4] TiO_2 films may be prepared by hydrolysis in the vapor phase, using as the film-forming raw material TiCl_4 and CCl_4 . Titanium dioxide films were obtained by the photon annealing of coating solution based on titanium alkoxy compound [5].

In our work to produce TiO_2 films we used the metalorganic extracts with subsequent thermal decomposition on the substrate. Compared with the titanium alkoxide used in the sol-gel method, organic extracts have better wetting properties and stability of properties over time due to the non-volatility of the organic phase. Complete wetting of the substrate is necessary to achieve coating uniformity and strengthening the binding of the interface substrate-coating, particularly for low energy surfaces (glass, plastic). Wetting agents provide the reduced surface tension, spreading, wetting, improving adhesion, improving the appearance (gloss and color uniformity).

Extracts with different concentrations of titanium, which determines the microstructure, have been prepared and obtained layers were investigated. Fig. 1 shows an AFM micrograph of TiO_2 films, prepared from 0.1 M and 0.25 M solutions of extracts of titanium.

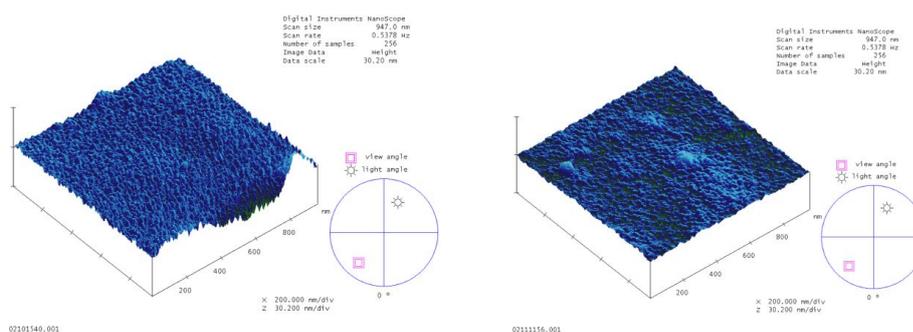


Fig. 1. AFM micrographs of TiO_2 films prepared from 0.1 M (a) 0.25 M and (b) the extract solution of titanium

Judging from the microphotographs TiO_2 films obtained from dilute extracts solutions are possess of continuity, nonporous and can be used as protective coatings. Nanoscale film structure contributes to the absence of pores and cracks, thereby improving the coating performance.

We investigated the aterproof and photocatalytic properties of TiO_2 films. The steel needles protected by TiO_2 film and unprotected needle were placed in the water under the open sunlight. After 5 days the not protected needle is covered by rust and the protected by TiO_2 film needle retained its original form (Fig. 2).



Fig. 2. Needle coated by TiO_2 film (right) and not protected steel needle (left).

It is shown that the film TiO_2 obtained from the extract solution after pyrolysis at $450\text{ }^\circ\text{C}$, has a protective anti-corrosion and anti-fouling properties.

References

1. Ogawa Katsuki, Takata Sadaki, Kumagaya Shigenori. Cosmetic composition containing spindle shaped fine particles of titanium dioxide: Pat. 6123927 United States, IPC {7} A 61 K 7/42; Shiseido Co., Ltd., N 08 / 860918 Opubl. 26.09.2000; (Japan); NPK 424/59
2. Janke Nikolas Self-cleaning glass // Galvanotechnik. 2005. 96, № 10. P. 2478–2482,.
3. Kuhn A. Methods of protective coatings of vessels// Galvanotechnik. 1999. 90, №8. P. 2153.
4. Kuznetsov G.N. Thin-film dielectric coatings and some methods of their study. L. : LTI them. Leningrad City Council, 1986. 56c.
5. Lynkov, TV Molodechkina, VA Bogush, TV Borbotko doped titanium and zirconium in technology of formation of protective coatings // Reports BSUIR. 2004. №3. S. 73-84.