Nanostructured surfaces

Development of the thin film UV filters using mathematical modeling

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ZnO nanostructured thin film are widely used in the optical, optoelectronic, and acousto-optic devices as UV filters, anti-corrosion and anti-reflective coatings, waveguides, transparent conducting electrodes. Development of the technological process of producing of UV thin film filter on the basis of ZnO by RF magnetron sputtering implies consideration of many different factors, such as: substrate temperature (T_S), composition and pressure of the working gas, RF power generator of oscillations, sputtering time, value of the magnetic field, distance from the target to the substrate, annealing environment, temperature (T_a) and time (T). All these parameters affect the film transmittance spectrum. In order to minimize the number of experiments, it is advisable to use the method of mathematical modeling. In this work the influence of T_S, T_a and T parameters was studied. Other parameters have been fixed. The mathematical modeling method was found to be effective in this case, since there was obtained the filter with the optimal spectral characteristic at T_S = 200°C, T = 28 min and T_a = 302°C. Twenty experiments were carried out to achieve these optimal values (16 preliminary and 4 – within the "steep climb" approach). At usual approach without mathematical modeling, it would be necessary to perform 64 experiences to reach the above mentioned results.

Fig. 1. Transmission spectrum of the optimized UV thin film filter.