

## **Electrical and Optical Properties of Self-Assembled Porous Alumina Structures Filled with Iodine Nanoparticles**

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Recently porous anodic alumina (por  $Al_2O_3$ ) has become a popular template system for the synthesis of various nanostructures. In this work physical properties of por  $Al_2O_3$  host matrix filled with iodine guest substance (I/por  $Al_2O_3$  nanocomposite) were studied.

Self-assembled porous alumina structures were prepared by two-step anodization process. Firstly, aluminium sheet was degreased and polished. Then anodization was performed at 40 V in 0.3M oxalic acid at 8°C for 5 h. After that the oxide layer was chemically removed. The second anodization step was performed for 5.5 h under the same conditions.

To incorporate iodine species into quasi one - dimensional parallel nanochannels of por  $Al_2O_3$  host matrix, vapour phase adsorption at 175°C under iodine vapour pressure ~140 kPa for 7 h was used, resulting in the I/por  $Al_2O_3$  nanocomposite formation.

Dielectric measurements of the I/por  $Al_2O_3$  samples were carried out at the frequency of 1 kHz by an E7-13 impedance meter upon continuous warming with a heating rate of ~1°C / min. Spectra of ellipsometric parameters  $\Psi(\lambda)$  and  $\Delta(\lambda)$  of the samples under study were characterized by the spectroscopic ellipsometer “Ellips-1891”.

The measured conductivity G and capacity C values of the I/por  $Al_2O_3$  nanocomposite are  $10^2$  or  $10^3$  times larger than those of the host matrix. Their temperature dependences G(T) and C(T) demonstrate peculiarities at ~70°C. This temperature was previously attributed to the phase transition of iodine species in the one-dimensional nanochannels of AFI zeolite-like nanoporous aluminophosphate from the chain structures to molecular iodine.

According to our ellipsometric data, por  $Al_2O_3$  film thickness is ~10 microns. There exists a marked difference  $\Delta n \approx 0.25$  between the effective refractive index of the I/por  $Al_2O_3$  nanocomposite and that of the por  $Al_2O_3$  matrix in the visible spectrum.

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In summary, novel I/por  $Al_2O_3$  nanocomposite prepared by infiltration of por  $Al_2O_3$  matrix with iodine guest substance was characterized by electrical and optical measurements. Experimental results prove the occurrence of the phase transition of iodine species from the chain structures to molecular iodine at  $\sim 70^\circ C$ .