STUDY OF THE ABSORBING SPECTRA OF NANOSTRUCTURED MATERIALS BASED ON THIN FILMS OF METAL OXIDES IN THE MIDDLE IR RANGE

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At present, an increase in the absorption coefficient A_λ of materials in the middle IR range is very important for the development of promising bolometric sensors and intensification of radiation heat transfer. For example, thin-film (with typical thicknesses $h = 10\ldots100$ nm) coatings on various substrates can be IR absorbers [1]. In this case, films of metals, semiconductors, as well as their oxides, nitrides, etc. are used [2].

Using the Drude theory [3] the optical properties of some metals (Ti, Cr, etc.) have been calculated. As a result, the spectral refractive indices n_λ, the extinction coefficients k_λ, and the absorption coefficients A_λ were determined at $\lambda = 2.5\ldots15\mu$m and $T = 300\ldots1000$ K.

The creation of samples of thin-film absorbers based on titanium oxides was carried out by ion-beam sputtering of a Ti target in a mixture of argon and oxygen at a gas mixture pressure of about 3 mPa, followed by deposition of atoms on a silicate glass substrate. The resulting coatings were subjected to a complex study in order to establish the features of their structure and to obtain data on their absorbing rate.

It was shown that the characteristic thickness of the films is about 600 nm. The absorption spectra of the original substrate as well as the coated substrates were studied for two cases: i) a radiation incident on the coating side and ii) on the filmless side. For all the systems studied, the dependences are essentially nonmonotonic in nature with the presence of several extrema in the investigated range of λ.

Summarizing the results of the studies, one can say that thin-film coatings based on Ti oxides with a thickness of ≈ 600 nm can be recommended to increase the absorption of middle IR radiation. The use of such coatings makes it possible to achieve a mean integral absorption $\bar{A}_\lambda \approx 0.37\ldots0.39$ in the range $\lambda = 2.5\ldots15\mu$m, which is 3…4 times higher than that of silicate glass substrates.

1. Lodenquai J.P. // Solar Energy, Vol. 53. No 2. pp. 209-210.
2. Jiang B. et al. // ECS Transactions, Vol. 64. No 8. pp. 179-183.
3. Arnold G.S. // Applied Optics, Vol. 23. No9. pp. 1434-1436.