Секция 1 «Новые материалы и технологии»

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HIDING OF HEAT RADIATION BY MEANS OF NANOPOROUS ANODIC ALUMINA FILMS

Currently two types of the IR imaging cameras are used for visualization of thermal images of objects: the cooled IR imaging cameras operating in the short-wave range (3-5 microns) and the non-cooled IR imaging cameras in the medium range (8-14 microns). For the detection and identification of thermal facilities, such as a person with the length of the spectral thermal radiation of 9.3 micron, the non-cooled IR imaging cameras are used.

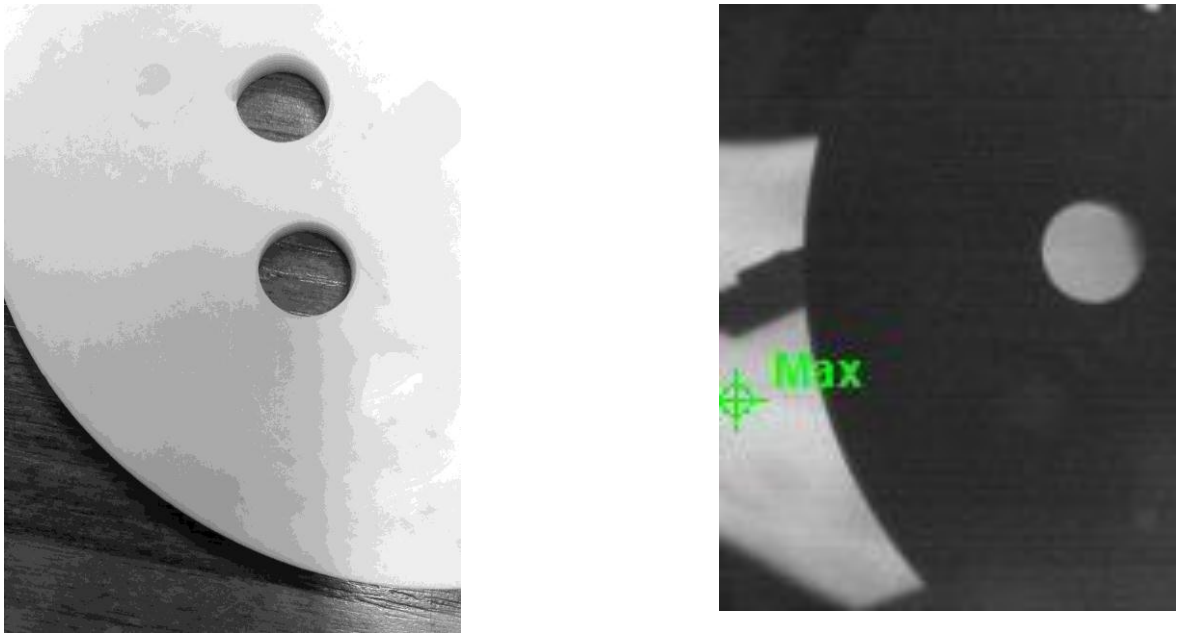
Along with development of thermal scanning technology an intensive search is conducted for new materials with ability to absorb and dissipate the heat radiation and thus it ensures hiding object for observing in the infrared range.

This paper presents the results of studies on the effect of the mask from nanoporous anodic alumina on contrast of thermal radiation of human on the screen of the non-cooled IR imaging camera. To investigate the pattern of the thermal field in the experiments the non-cooled IR camera (IR imaging camera system MobIR 4) was applied. To create heat spots with human temperature PTFE (polytetrafluorethylene) plate with two holes of diameter of 14 mm was used. PTFE plate was placed over the human palm, blocking the main heat radiation and passing one only through two holes. The nanoporous anodic alumina films used as a mask were prepared by anodizing of the aluminum foil of thickness of 100 microns in 0.4 M aqueous solution of oxalic acid at a potentiostatic mode at 60 V.

In experiments nanoporous anodic alumina film was placed on PTFE plate over one from two holes. PTFE plate was positioned so that the mask of the nanoporous anodic alumina film was away from the bioobject on distance of 3-5 mm. In our experiments, a second hole through which heat radiation pass without obstacles, was the control heat spot for evaluation of the masking effect. Figure 1 shows the obtained results.

The results of thermal studies have shown that the temperature of the palm, measured from the outside and through the hole in the PTFE plate is almost the same ($\Delta T \sim 0.6$ °C). The small difference in values is due to the heterogeneity of distribution of heat across the palm. The temperature at the surface of PTFE plate was around 30.3 °C, and in the hole with heat radiation from the palm was 34.5 °C. The results presented showed that the nanoporous anodic alumina film located on the 5 mm thick PTFE plate provides effective shielding of the heat radiation of human body.

At the same time the changing in the temperature for the biological object recorded with and without anodic alumina film was not more than 4-5 °C.



a) b)

a – photo of PTFE plate with two holes;
b – thermal picture of PTFE plate with two heat spots from the biological object in the case of masking one hole using nanoporous anodic alumina film

Figure 1 – Thermal investigations

Although optical clarity in the visible range, the nanoporous anodic alumina films markedly attenuate transmission of radiation in the medium range (λ = 8-14 microns), which may allow to use their as a filter for absorbing of radiation from biological objects.

The present study showed that the nanoporous anodic alumina films have good insulating and shielding properties for IR radiation in the wavelength range of 6-16 microns and they can be used as heat shields to smooth contrast heat radiation of the object and the surrounding background and therefore to improve the efficiency of heat masking of objects.