LIGHT-ABSORBING COATINGS FOR HEATING SYSTEMS

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Providing the surface with necessary optical characteristics allows solving a number of complex problems, for example, creating various heating systems under radiant heat exchange conditions. Ensuring the surface properties under such conditions is achieved by using light-absorbing coatings. The low-temperature thermal radiation obtained with the help of such coatings can be used in thermal collectors that convert solar radiation into thermal energy. The efficiency of solar collector can be significantly increased by using selective absorbing coatings on the heat-receiving surface, which have the property of effectively absorbing the visible part of solar spectrum and practically not emitting energy in the infrared spectrum region.

At present, various types of light-absorbing coatings of organic and inorganic nature are used. Some of them are formed by electrochemical treatment of the surface of metal alloys or by applying organic paints. This type of coating has a number of significant disadvantages: low efficiency of solar energy absorption, environmentally harmful production, low stability of coating properties. Coatings based on low-vacuum aluminum condensates are a promising alternative to existing coatings. They are formed by simultaneous application to the substrate of dispersed particles formed as a result of volume condensation and deposition of a molecular flow, which ensures fixation of large particles, creating an adhesively strong complex film system with a highly developed surface and porosity. The presence of a labyrinth of open submicropores provides aluminum condensates with a high absorption factor ($A_S > 95$ %) in the visible and infrared spectrum regions, which makes the optical properties of these coatings close to the properties of an absolutely black body. Low-vacuum aluminum condensates have selectivity when, with high absorption in the visible region of the spectrum, they demonstrate low emissivity in the region of thermal radiation. This makes them relevant for use in solar collectors.

Thin selective coatings in the initial state were characterized by a low reflectivity in the ultraviolet and visible regions of the spectrum and a sharp increase in the wavelength range from 2.5 to 5 μm. This behavior is due to the fact that the dimensions of the coating surface roughness are comparable with the wavelengths of the ultraviolet, visible and near infrared regions of the spectrum. Low-vacuum aluminum condensates are characterized by high porosity, have a developed surface and high structural defectiveness. Therefore, the contribution of radiation damage that occurs during their operation is insignificant against the background of high structural defectiveness. This ensures the effect of high stability of the optical and thermal radiation characteristics of selective coatings under the radiation effect of corpuscular particles. As a result of the tests, it was found that the efficiency of using a solar thermal collector in which a film with the proposed selective coating is used increases by an average of 20 %.