SOLAR SELECTIVE CARBON COATINGS

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A carbon coating, having a high absorption capability for solar energy, has been developed and demonstrated. The coating consists of carbon particles of a selective size range, bonded to a metal plate with an appropriate inorganic or organic binder. The carbons and graphites used in this demonstration are those with a particle size near the wavelengths of the infrared/visible light boundary.

The heat-treated (2800° C) spherical Thermax powder used in our work with an acrylic resin binder had an average particle diameter of 0.57 micrometers and is shown in Figure 1. A larger diameter microspheroidal carbon powder (approximately 150 micrometers) having a selective absorbing surface was also used and its surface morphology is shown in Figure 2.

Two commercial flat-plate solar collectors (10 square feet each) were used to compare a selective carbon coating with black velvet paint. One collector was sprayed with a microspherical Thermax carbon powder/acrylic resin/mixed solvent formulation and the other collector was sprayed by the manufacturer with a commercial black velvet paint.

The microspheroidal-carbon solar collector coating consisted of a fluid mixture of 16.0 wt.% carbon powder, 0.5 wt.% acrylic resin, and 83.5 wt.% mixed solvents comprising equal volumes of xylene, methyl ethyl ketone, and methylene chloride. Five ounces of the fluid mixture were used to obtain a uniform coating having a thickness of approximately 1/3 mil over the 10 square feet of collecting metal surface. Estimated material cost of the black coating presently used by the panel manufacturer is $4.50 per 2' by 5' (10 sq. ft.) collector surface; the estimated material cost for the proposed solar selective carbon coating is approximately $0.20 per collector. A statistical evaluation of the outlet water temperature from the two collectors, measured at equal water flow rates, showed that the total heat collected by the selective-carbon-coated collector was significantly higher than that of the heat collected by the black velvet paint-coated collector.

A typical experimental efficiency of the carbon-coated collector was calculated to be 62.4%, and for the black velvet-coated collector, it was 57.4%. These efficiencies would be somewhat higher if the solar panels had been at an optimum angle of orientation with respect to the sun's incident radiation instead of being horizontal. A solar-absorbing coating capable of withstanding higher temperatures would result by using selective carbon particle fractions with a high-temperature binder.

Report Y/DA-6701, "Selective Absorptivity of Carbon Coatings," by J. M. Schreyer, C. R. Schmitt, J. M. Googin, and H. D. Whitehead is available upon request.

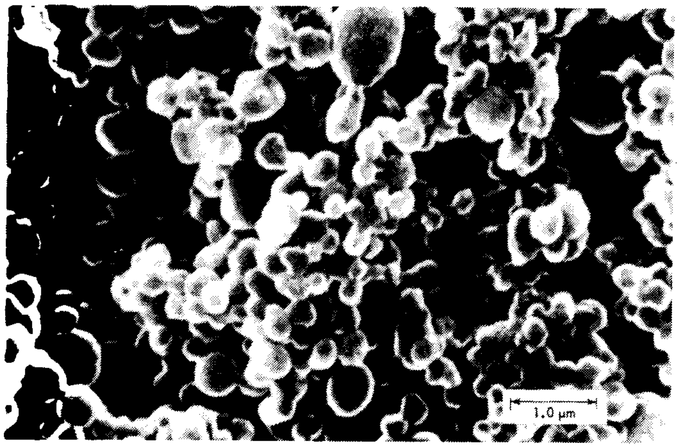

Fig. 1: The Heat-Treated, Thermax/Acrylic Coatings Contain Small, Spherical Particles

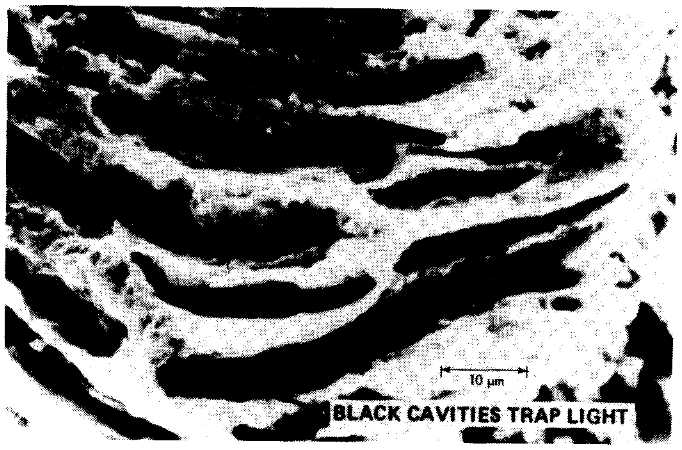

Fig. 2: Selective Absorbing Surfaces May be Formed by Controlling the Surface Morphology

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