EVAPORATION PROCESS OF ALUMINIZING OPTICAL SURFACES

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Previous experiments have shown that by using thin films of pure aluminum condensed on optical surfaces it is possible to obtain highly reflective surfaces of great endurance. The purpose of this experiment has been to become familiar with the vacuum and evaporation technique used in this process.

The apparatus was mounted on suitably spaced supports in a welded tubular frame. A machined steel plate formed the base of the evaporation chamber. The vacuum system was connected to the evaporation chamber through a 3 cm. hole in the plate. The top of the chamber was made of an 18 inch section of 12 inch steel casing, the top being closed by a disc of ¼ inch boiler plate machined to fit the tank. Two filaments were suspended from the top plate and insulated from it by means of glass discs sealed over ports drilled in the plate. A three inch window was also placed in the top. The filaments, of 30-mil tungsten wire, contained 10 loops approximately 8 mm. in diameter. Only one of the filaments was used in this experiment. On each loop was suspended a small U of No. 12 pure aluminum wire.

The surface to be aluminized was placed on suitable mountings in the base of the chamber. A mixture of one-half bee's wax and one-half rosin, applied with a medicine dropper, was used to seal the chamber. The tank was then coated with Glyptal to seal any pin-holes that might have been present. The system was then evacuated with a Cenco Megavac pump in conjunction with the usual mercury diffusion pump. In this way the pressure in the chamber could be reduced to approximately 1×10^{-5}mm. of mercury.

Before aluminizing, the mirrors had to be cleaned thoroughly, a function most essential for securing the best results. The surface to be aluminized was scrubbed with Ivory soap and tap water, using a cotton swab, and again scrubbed and rinsed with distilled water. After drying, the surface was polished, first with lens paper, then with a linen cloth free from lint.

At frequent intervals during evacuation the mirror was subjected to a high voltage discharge. The discharge was obtained through the use of a 100 watt transformer connected to an electrode sealed in the top of the tank. This discharge completed the cleaning process by removing any thin film of organic matter which might be present on the surface to be aluminized. The entire apparatus was well grounded to prevent feed-back through the small filament transformer.

To aid in keeping this surface clean it is imperative that no wax be exposed inside the chamber. If wax is exposed, the high temperature developed during the process causes the wax to evaporate, placing a thin film of wax on the surface. Such a film prevents adherence of the aluminum to the glass, with resultant blistering and peeling.

When testing shows disappearance of the discharge in the chamber, current is applied to the filament through the filament rheostat and a step down transformer. The current and voltages in this experiment were 37 amperes and 2.67 volts. The small U's of aluminum then melt. Surface tension prevents the droplets of molten aluminum from dropping from the hot filament. Aluminum evaporates and condenses on the mirror and cooler parts of the chamber.

That a proper vacuum was present during the evaporation is indicated if there are well defined shadows of objects in the chamber on the walls of the tank. One result of a poor vacuum is the blue, smokey appearance of the mirror surface. This may, however, be the result of depositing too heavy a film on the surface, or of the presence of impurities on the surface or in the aluminum wire. If the aluminum is merely coated with surface dirt, this may be removed before aluminizing by a preliminary evaporation. To prevent coating the tank during this preliminary evaporation, a metal baffle may be used over the filament.