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SOLDERING ALLOY

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This invention relates to alloys and their use and more particularly to alloys which are suitable for soldering to thin metal objects, such as metallic films or coatings and fine wires.

Heretofore difficulty has been experienced in soldering metal bodies to thin metallic films or coatings or fine wires with the soldering alloys known to the art. It has been found to be particularly difficult to solder a metallic member to a thin metal film or coating, for example, of silver or gold, and such an attempt often has resulted in the destruction of the thin metal surface. Various expedients have been employed to prevent the destruction of the thin metal but none have been wholly satisfactory.

The primary object of the invention is to prevent the destruction of thin metallic films or fine wires by soldering operations.

Another object of the invention is to inhibit solution of the film or wire component in the solder.

A further object of the invention is to form alloys for soldering which do not attack the surface to which a metal is soldered.

Other and further objects and features of the invention will be apparent from the following description of certain exemplary embodiments thereof.

A feature of the invention is an improved method of soldering a metal object to a thin metallic coating, film, or filament by first saturating or partially saturating the solder with the same metal as that of the thin metal part, thereby preventing destruction thereof by absorption in the solder.

A study of the pertinent phase diagrams in connection with successful operations with certain soldering alloys indicates that there is a group of low melting point metals (under 350 degrees C.) in which a second group of higher melting point metals (above 700 degrees C.) are only slightly soluble and dissolve without destroying the fluidity of the metals of the first group. Exemplary of the first group are: lead, tin, bismuth, thallium and cadmium; and of the second group: silver, gold, platinum, copper and nickel. It, therefore, appears that where it is desired to solder to thin bodies of metal of the higher-melting-point group, a successful operation results when the solder comprises one or more metals of the low-melting-point group saturated or partially saturated with the same metal as that of the thin body.

In carrying out the teachings of this invention it has been found that by saturating a lead solder at working temperature with silver, the above-described difficulties are overcome. By the use of a saturated solution of the lead-silver alloy, the solution of the thin film of silver at the working temperature of the solder is prevented. A lead-silver solder having a 7 per cent silver content may be employed to solder to a thin film of silver without dissolving the thin film. However, when the concentration of the silver is below 1 per cent, the solder dissolves the thin film.

In the case of a tin-silver solder at the working temperature of the solder, the phase diagram shows a tin-silver compound of the composition Ag_3Sn. Experiments with a 7 per cent silver-tin solder, at which composition silver is in the form of the above compound, indicate that the solution of the thin film of silver is inhibited to such an extent that the alloy could be satisfactorily used for soldering to thin silver films.

It appears that the above-noted difficulty in the use of ordinary solder is due to the thin silver surface being absorbed by the molten solder. In the lead-silver solder of this invention, since it is already substantially saturated with silver, the silver surface does not flow into the solder, and in the case of the tin-silver solder, the rate of solution is so inhibited by bringing the silver into equilibrium with the tin-silver compound that successful soldering operations result.

Advantages in certain cases have been found by employing an alloy solder of lead and tin in the approximate ratio of 5 to 4 with from 1 to 13 per cent silver. The proper amount of silver is a variable determined by the temperature at which the soldering is performed. A particular composition which produces good results for soldering a wire to a silver film is lead 50 parts, tin 40 parts and silver 10 parts. With this composition the soldering is done without destroying or harming the film.

Where it is desired to solder thin filaments or films of gold, alloys similar to those used for silver give good results. A lead-tin alloy having the lead and tin in the ratio of approximately 5 to 4 and the gold ranging from 1 to 13 per cent of the whole is satisfactory. Gold forms compounds with lead and tin as may be shown by reference to phase diagrams. Once the solution has been saturated with gold, further rate of solution of the gold is inhibited so that a successful soldering operation may be performed. Using an alloy of lead 49.7 per cent, tin 39.8 per

cent and gold 10.5 per cent, a gold filament was soldered without harm to a gold film.

In soldering to thin films or filaments of copper similar means and methods may be employed. A suitable lead or tin or lead-tin solder is saturated or partially saturated with copper at or near the soldering temperature and the resulting alloy used to solder to the thin copper body. The proportions of copper may be varied from 1 to 13 per cent with satisfactory results.

A thin film of copper has been successfully soldered by employing a lead-copper solution (eutectic 2 per cent copper) as the solder. The thin film of copper was not harmed in this operation. However, when lead alone was used as the solder, the film was damaged by the copper going into solution in the lead.

In soldering to thin films of platinum in accordance with this invention, a lead-platinum solder with the platinum in the range of from 1 to 13 per cent, is suitable. Employing a solder comprising 94 per cent lead and 6 per cent platinum in soldering to a thin film of platinum on glass, a satisfactory joint is obtained without harm to the film.

While the invention has been described with respect to several specific illustrative embodiments thereof, it is to be understood that it is not limited thereto but by the scope of the appended claims only.

What is claimed is:

1. A soldering composition composed of from 3 to 13 per cent of silver, 54 to 48 per cent lead and 43 to 39 per cent tin.

2. A soldering composition for use on a surface of gold, silver, or platinum, composed of 54 to 48 per cent lead, 43 to 39 per cent tin and 3 to 13 per cent of a metal corresponding to the surface to which the composition is to be applied.

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