

SILVER MIRRORING

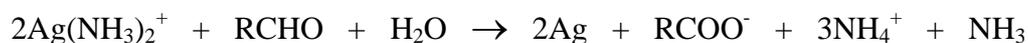
Silver mirroring is a process that was once carried out widely in New Zealand, and is still used to a small extent - particularly for restoring antique mirrors. It involves the plating of glass with a thin layer of silver, and the protection of this layer, and is carried out in a three or four step process depending on the method used.

Step 1 - Preparing the glass

The glass is washed and polished and then coated with stannous chloride. This "tinning" process ensures a good bond between the silver and the glass.

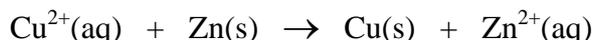
Step 2 - Silver application

A solution of silver salt is mixed with an aldehyde solution, and the mixture sprayed on the mirror. The silver and the aldehyde react as follows to produce a coating of metallic silver:



Step 3 - Copper protection

This step is not always used, but it is useful in providing further protection for the silver backing. It simply involves the spraying a mixture of copper ions and zinc dust onto the silver, producing metallic copper as follows:



Step 4 - Protecting the backing

The mirror is then backed with paint to prevent damage to the surface.

INTRODUCTION

A mirror is simply a sheet of glass with a very thin layer of silver metal on the back surface. The majority of mirrors currently available in New Zealand have been made overseas, but a small number of novelty mirrors are made locally. A typical mirroring process is outlined below.

THE MANUFACTURING PROCESS

Step 1 - Preparing the glass

The important first stage in the mirroring process is to clean the glass surface to be silvered. The surface is normally washed and polished with ceri-rouge, a very fine abrasive powder, and washed again, the final washing being with distilled water. The surface is then "tinned" by spraying on a solution of stannous chloride dissolved in distilled water, and washing again with distilled water. The stannous chloride remaining is important in making a good bond between the glass and silver.

Step 2 - Silver application

The silver is produced chemically as it is applied to the glass by reducing a silver salt

solution. Typical solutions would be:

Silver solution

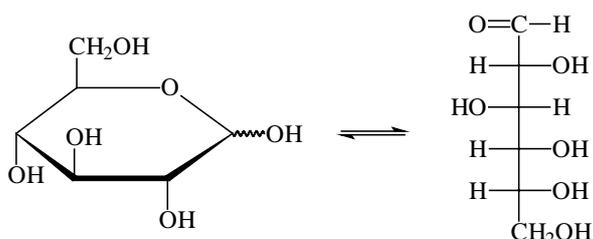
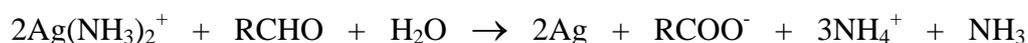
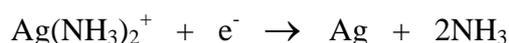
- 78 g of silver nitrate
- 78 g of sodium hydroxide
- 220 mL of 0.880 ammonia
- 18-20 L of distilled water. *Reducing*

solution

- 150 g sucrose (sugar)
- 3 mL of 40% formaldehyde solution
- 4 mL concentrated sulphuric acid
- 18-20 L distilled water

The solutions are mixed in a two jet spray gun and sprayed on to the surface of the glass to give a layer of silver up to 3 nm (3×10^{-9} metres) thick. The silver may also be applied by a "rocking table" in which the solutions are mixed over the glass which is rocked to and fro, or by pouring the solutions over the glass as they mix.

The chemistry of this process is also used in the laboratory in Tollen's test for an aldehyde (the silver mirror test). Aldehydes are easily oxidised to the corresponding carboxylic acids, and in doing so they reduce silver ions to metallic silver. The reaction goes under alkaline conditions. Ammonia is used to form the diammine silver complex ion and thus prevent the precipitation of insoluble silver hydroxide or silver oxide. Note that sucrose is actually a "non-reducing" sugar and so cannot itself be oxidised to a carboxylic acid. However, it hydrolyses to glucose and fructose in the acidic solution, and glucose is a reducing sugar¹.



¹For a sugar to be reducing, it must have an aldehyde group on it. Most glucose molecules in solution do not have a free aldehyde group as they are present in the ring form. However, this sugar ring is in equilibrium with a small amount of open-chain aldehyde (see left), and it is this which undergoes the Tollen's reaction.

Step 3 - Copper protection

Some firms put a copper backing over the silver surface. Again this is done by reducing a cupric salt with a zinc suspension just prior to application.

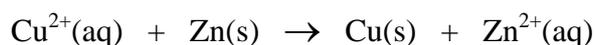
Copper solution

- 1.5 kg copper sulphate
- 100 mL concentrated sulphuric acid
- 23 L distilled water

Zinc suspension

- 420 g zinc dust
- 27 L distilled water

The copper solution is mixed in a spray gun with the zinc suspension, the zinc reducing the copper ions to copper.



Step 4 - Protecting the backing

After the application of the metals, the mirror is thoroughly dried in a hot booth to remove all moisture, and then the back is spray-painted with a special paint to protect the metal surfaces.

Resilvering

Where old mirrors are to be re-silvered, the mirror is soaked in dilute hydrochloric acid for about two days, the old paint and silver layers lifting off. The glass is then resilvered using the above process.

Written for volume one of edition one by John Packer, after visiting Mr. T. G. Walker at Phillips & Impey Ltd., Auckland.