

## Heating Plate for CVD Apparatus Used in Manufacturing TFT LCDs

Liquid crystal display (LCD) based on the thin film transistor (TFT) technology is expanding rapidly focusing on personal computers and TV sets. In particular, the expansion of the use in TV sets is going to accelerate drastically the size increase of TFT LCDs.

In an effort to supply a heating plate (see Figure 1) to be used in chemical vapor deposition (CVD) apparatuses in manufacturing TFT LCDs, Furukawa Electric has developed a proprietary technology of aluminum plate welding, thereby promoting development and practical application of such heating plates as are applicable to manufacturing large-sized displays.

### 1. STRUCTURE

Figure 2 shows the basic structure of Furukawa's heating plate. Two aluminum alloy plates are bonded together by hot forging, with heating wires such as sheathed heaters sandwiched in between, to obtain an integral heating plate, in which forge welding process is employed to achieve metal-to-metal bonding.

In the forge welding process as shown in Figure 3, the portions to be welded that are formed in advance into a protrusion-groove (or protrusion-protrusion) shape undergo a rapid and concentrated deformation instantaneously, so that metal-to-metal bonding is enhanced to attain a high level of bonding strength ensuring simultaneously a high degree of sealing against high vacuum.

The forge welding process offers a number of advantages such that the process permits partial bonding of any desired portions by preparing the protrusion-groove (or protrusion-protrusion) shape mentioned above; in case airtightness is required, a high degree of sealing against high vacuum is achieved by making the protrusion-groove (or protrusion-protrusion) portions into annular in shape; and the process requires only a small amount of forging force due to the force concentration onto the protrusion-groove (or protrusion-protrusion) portions, making the process capable of coping with large-sized products.

Features of Furukawa's heating plate fabricated using the above mentioned forge welding are described below.

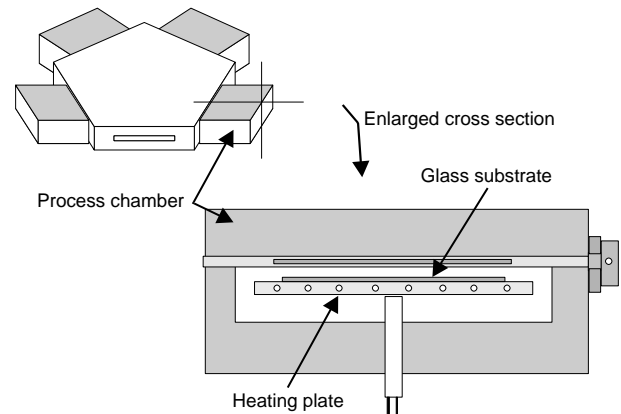


Figure 1 Schematics of CVD apparatus and cross section of heating plate.

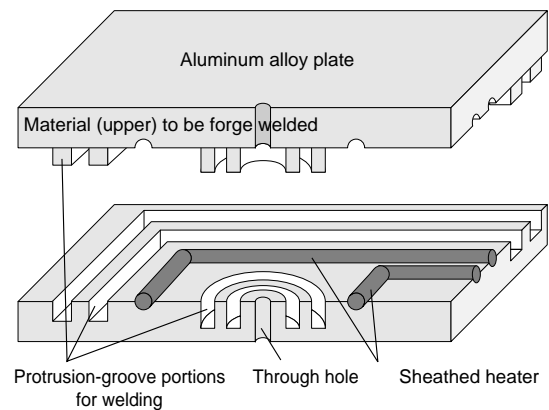


Figure 2 Structure of heating plate.

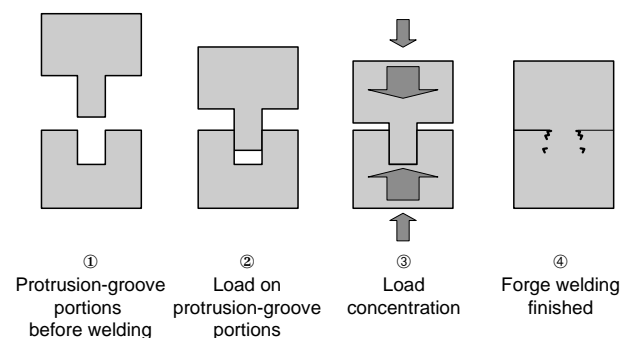


Figure 3 Details of forge welding process.

## 2. FEATURES

- 1) Stabilized performance is maintained even when used in a high vacuum.  
Heating plates of high cleanliness with stabilized performance when used in a high vacuum can be supplied, since the products are fabricated by forge welding, a proprietary technology of Furukawa Electric, where aluminum alloy plates are metal-to-metal bonded with heaters sandwiched in between. The airtightness is confirmed to be  $10^{-10}$  Pa·m<sup>3</sup>/sec or less by helium leak test.
- 2) Large-sized heater plates are available.  
Product sizes can be freely selected up to a heater plate of about 2 m square.
- 3) Excellent in uniformity of temperature distribution.  
Because the heating plate is forge welded in a high-temperature and high-pressure condition, the aluminum alloy plate and the heating wire come into close contact with each other, thereby ensuring efficient heat conduction. Thus, a heating plate that is excellent in uniformity of temperature distribution can be obtained.
- 4) Surface deformation can be minimized.  
Because the heating plate is forge welded in a high-temperature and high-pressure condition using a metal mold of sufficient surface flatness, a satisfactory surface flatness after welding is assured. This results in a minimal residual stress thanks to avoiding the sizing process. Furthermore, the heating plate is forge welded in a high-temperature equivalent to the ambient temperature of an actual process, so that strain during the use is also reduced.
- 5) Hollow passages are possible to be provided.  
It is possible to leave the grooves prepared for heaters unfilled without embedding heaters, so that aluminum panels provided with hollow passages for liquids or gases can be manufactured.
- 6) Aluminum alloys can be freely selected for welding.  
Aluminum alloys such as 1050, 3003, 5052 and 6061 that are generally used in semiconductor manufacturing equipment can be forge welded.

## 3. MANUFACTURING TRACK RECORDS

- 1) Size  
250 mm square~1200 mm square; circular panels included
- 2) Material  
1050, 5052 and 6061 aluminum alloys
- 3) Applications  
Heating plate for CVD apparatus  
Cooling plate for semiconductor manufacturing equipment  
Gas diffusion plate for semiconductor manufacturing equipment

## 4. IN CONCLUSION

Furukawa's heating plate is based on a simplified bonding method of forge welding, which also permits meeting the needs of size increase.

In addition to such a function of heating with built-in heaters, it is possible to provide hollow passages for liquids or gases within the aluminum alloy plates ensuring a high degree of sealing. Using this technology, therefore, we are ready to meet various customer requirements in terms of size and application including heating plates, cooling plates and gas diffusion plates.

Please note that several patents have been filed by Furukawa Electric.

For more information, please contact:

Manufacturing Department, Casting & Forging  
Division, Aluminum Group  
TEL: +81-285-24-0747  
FAX: +81-285-22-2884