INDIUM BUMP ELECTROPLATING OF WAFERS USING PULSE PLATING

Wafer Bumping

Wafer bumping using indium metal is becoming more prominent due to the low melting point, deformability, and cold welding properties of indium metal, compared to more common solders such as the Sn63/Pb37 alloy and the SAC (tin-silver-copper) alloy series of lead-free solders.

Evaporation, sputtering, the use of ultra-fine powder solder paste, and electroplating are all processes that can be used for indium wafer bumping. Of these, electroplating is attractive because it is a non-vacuum process that utilizes inexpensive equipment, has deposition rates that are reasonable, and the process itself has relatively low operating costs. However, all soft metals, such as lead, tin, and indium, have a tendency to produce relatively large crystals grains during electrodeposition. Therefore, parameters need to be carefully controlled to ensure the deposit has a fine crystalline structure that will not short between adjacent close-pitch bumps.

Pulse Plating

One method to ensure a fine deposit is to use pulse plating rather than conventional direct current. Unlike steady direct current from a common full wave rectifier, a pulse plate rectifier incorporates microprocessor-controlled circuitry where the waveform can be adjusted to be square, saw-tooth, or sinusoidal. The forward and reverse current cycle can also be controlled as to amplitude and cycle time. Thus, the current polarity periodically changes, resulting in the plating and de-plating of indium. To have a net deposit gain, the positive portion of the cycle where indium is deposited has to be greater than the negative portion of the cycle where indium is de-plated.

Pulse plating works because the negative portion of the cycle removes excessive indium in high current areas that plate at a faster rate than the low current areas. This results in an overall leveling or smoothing of the deposit and a denser, finer crystalline structure of the deposit. The variables in pulse plating are:

- Wave shape (sinusoidal, saw-tooth, or square)
- Ratio of amperage of the positive to negative cycle
- Time on in both the positive and negative cycles

Optimizing these variables for wafer plating must be done empirically, and most companies that have successfully done so consider the information proprietary. However, the following settings can be used as a starting point to optimize a specific wafer bumping process:

- Wave shape: square
- Ratio of amperage of the positive to negative cycle: 4:1
- Time on in the positive portion of the cycle: 1 millisecond
- Time on in the negative portion of the cycle: 15 milliseconds

APPLICATION NOTE

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