Microcanyons

Improperly cured adhesive can trap volatile substances,
forcing exit channels that bridge pads

Foresite Inc.

Nearly all electronics assemblers make some form of surface mount or mixed technology assembly. As such, surface mount components can be found in almost every assembly house, along with the adhesive used to secure those parts to the PWB surface. In a typical operation, the adhesive is dispensed very carefully, the component placed, and the assembly exposed to a thermal bake operation to cure the adhesive. Most adhesive manufacturers will provide a recommended cure thermal profile, or a maximum thermal ramp rate (e.g. 2°C / minute). This month's case study shows what happens when those guidelines are not followed.

The assembler in this case was a high volume manufacturer of control units for large scale industrial equipment. The assembler started getting large volumes of assemblies back from the field, usually with less than 100 hours of service, for failures. The root cause and cure were desired ASAP. The failed assemblies were examined and the failure mechanism was metal migration under the adhesive used to secure 0805 chips to the PWB surface. A fair percentage of the field failures also were examined which had No Trouble Found (NTF) by the assembler. Anytime you have large scale field failures, there is seldom a single source for the problem. The cause often has several components to examine.

We noted that the adhesive was applied in relatively high amounts. When some of the 0805 chips were popped off of the board, the underside of the adhesive, where the adhesive meets the PWB, was examined. We determined that the assembler was attempting to cure too much adhesive at too quick a rate (production pressures). In all other respects, the assembler had followed the manufacturers recommended procedure. The adhesive "skinned over" (the outer shell cured first) entrapping the remaining solvents and other volatile components. The entrapped materials attempted to find other ways to exit the mass of adhesive, as most any volatile material will do under these conditions. The result was often a channel formed at the interface of the PWB surface and the adhesive, bridging the two pads. The entrapped fluid in these channels had two effects. The first was that the fluid was weakly conductive and second, that the fluid tended to extract the high levels of halides that existed on the boards from the board fabrication process (another facet of the problem). When some of the boards were tested in laboratory ambient conditions (low humidity), the result was often an NTF. There was not enough humidity present to drive the electrical leakage failures. The failed boards which had metal migration also had high halide levels on the bare boards (5-19 micrograms per square inch of chloride).

At the time of submission, the assembler is working with the fabricator to clean up the bare boards, and has done several designed experiments on the adhesive issue. Initial indications are that by dispensing lower levels of adhesive (single dot vs. double dot) and subjecting the adhesive to a cure rate of less than the manufacturers recommended maximum rate, the bonding strength nearly doubles and the micro-channel phenomena seems to be greatly reduced.

Several other assemblers have experienced similar problems. When such microchannels have one outlet to the "outside world", capillary forces can pull in outside fluxes (such as water soluble fluxes) and no amount of cleaning will get it out. Entrapped water soluble fluxes are often corrosive and electrically conductive as well.

Moral of the Story: When all else fails, read the directions.