

METHOD 2021.3

GLASSIVATION LAYER INTEGRITY

1. PURPOSE. The purpose of this test is to assess the structural quality of deposited dielectric films (e.g., CVD, sputtered or electron beam evaporated glass or nitride, etc.) over aluminum metallized semiconductor devices or microcircuits. The test is directed at identifying process and materials related glass layer defects which result in localized contamination buildup and loss of the advantage given to properly glassivated devices in terms of electromigration behavior at elevated temperature and current density. This is a destructive test.

2. APPARATUS. The apparatus for this test shall consist of suitable sample handling and chemical etching facilities as required for personnel safety. Standard optical microscopes such as those employed in method 2010 shall be used for device inspection. Standard A.C.S. Reagent Grade chemicals shall be used as etchant materials.

3. PROCEDURE. Unless otherwise specified, this test shall be applied to devices which have been through the complete assembly cycle including final package seal. Packaged devices shall be mechanically delidded with minimum thermal stresses applied. Unless otherwise specified, the test sample shall consist of a minimum of one device selected randomly from the inspection lot. One of the following etching procedures shall be used.

3.1 Procedure A. Delidded sample devices shall be completely immersed in the following aluminum etch:

40 Volumes H_3PO_4 (85%)

19 Volumes H_2O

4 Volumes HNO_3 (70%)

This solution shall be maintained at a temperature of $50^\circ C \pm 5^\circ C$.

Devices shall be examined during the etching procedure with an optical system, such as a monocular, binocular or stereomicroscope compatible with observation of the immersed samples. Devices shall be etched for twice the amount of time required to completely remove aluminum metallization from exposed bonding pads.

Properly etched devices shall be removed from the heated solution, rinsed in distilled water, and blown dry with compressed air or other suitable gas streams.

Final optical inspection after etching and drying shall be performed at a magnification of 100X minimum.

3.2 Procedure B. Delidded sample devices shall be completely immersed for 20 to 30 minutes at room temperature in the following aluminum etch:

5 Volumes HNO_3 (70%)

80 Volumes H_3PO_4 (85%)

5 Volumes Acetic Acid

10 Volumes Deionized Water

NOTE: The use of a commercial equivalent (e.g., Mity Etch 2) is acceptable.

Properly etched devices shall be removed from the solution, rinsed in distilled water, and blown dry with compressed air or other suitable gas streams.

Final optical inspection after etching and drying shall be performed at a magnification of 100X minimum.

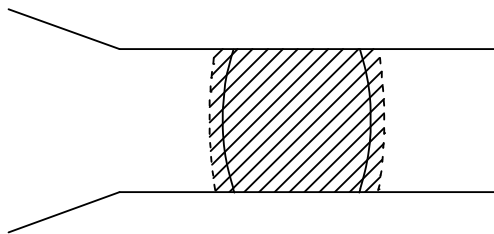


FIGURE 2021-1. Category A - missing glassivation over aluminum.

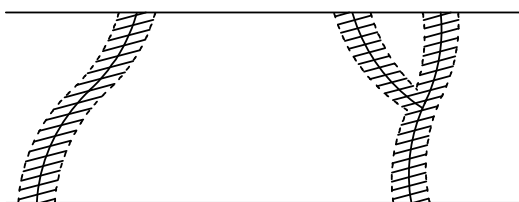


FIGURE 2021-2. Category B - cracks in glass over aluminum.

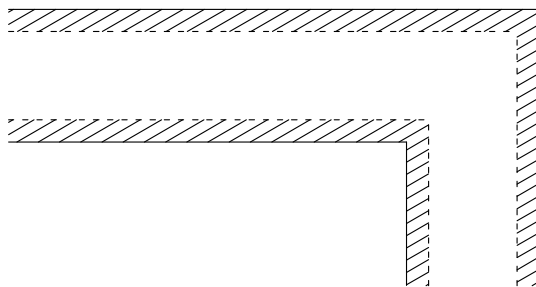


FIGURE 2021-3. Category C - cracks in glass or improper glass coverage along edge of aluminum.

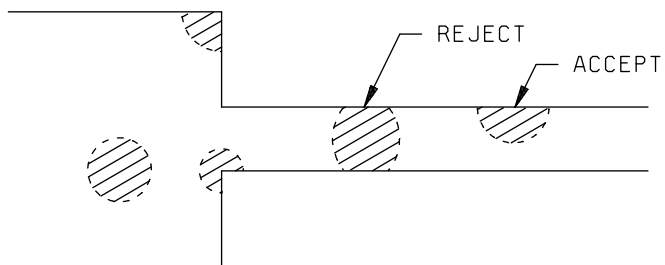


FIGURE 2021-4. Category D - pinholes in glass on top surface and edges of aluminum.

MIL-STD-883K
w/CHANGE 2

3.2.1 Failure criteria. Lot rejection shall be based on the appearance of etched aluminum, as shown on figures 2021-1 to 2021-7, at any location other than along the edges immediately adjacent to intentionally unglased areas (e.g., bonding pads, die edge, scribe line, etc.) (see 4). This criteria shall be applied only to the interconnect levels which exceed a calculated current density of 2×10^5 A/cm². Category C and D defects, shown on figures 2021-3, -4, -6, and -7 shall not be a cause for rejection unless aluminum is completely removed from the entire width of the conductor stripe. Etched aluminum is determined by changes in the reflecting properties or transparent appearance of areas normally covered with glassivated aluminum.

Failures shall be recorded in terms of the number of devices tested (if other than one) and the number of failures by failure category as defined below:

4. SUMMARY. The following details shall be specified in the applicable acquisition document:
 - a. When applicable, any intentional omission of glass over the aluminum metallization layer (see 3.1).
 - b. If applicable, specific magnification requirements other than as stated in 3.
 - c. Sample size if other than one (see 3).
 - d. If applicable, special reporting requirements (see 3.1).

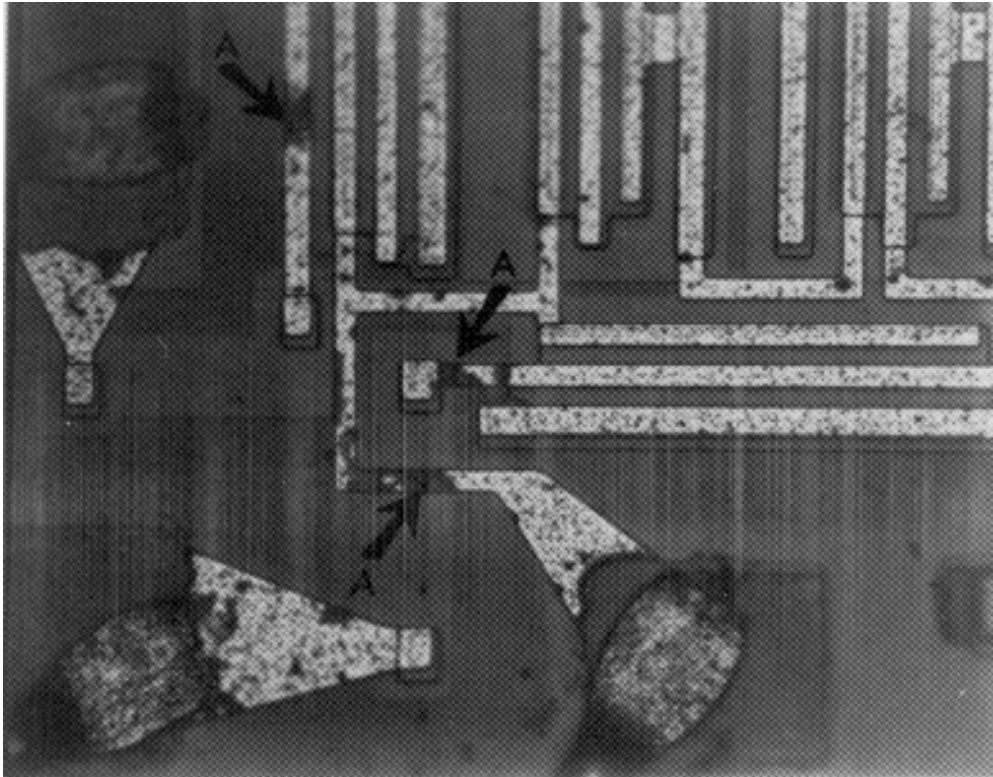


FIGURE 2021-5. Etched device exhibiting failure category A missing glass over aluminum.

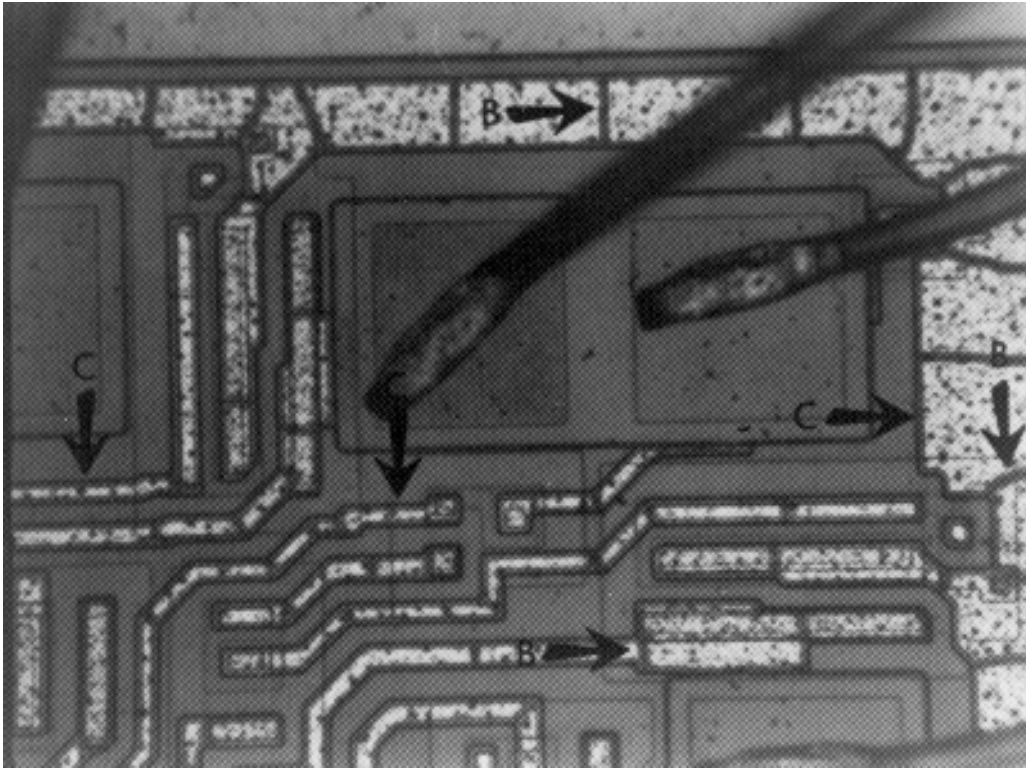


FIGURE 2021-6. Etched device exhibiting failure categories,
B - Cracks in glass over aluminum,
C - Cracks in glass or improper glass,
coverage along edge of aluminum.

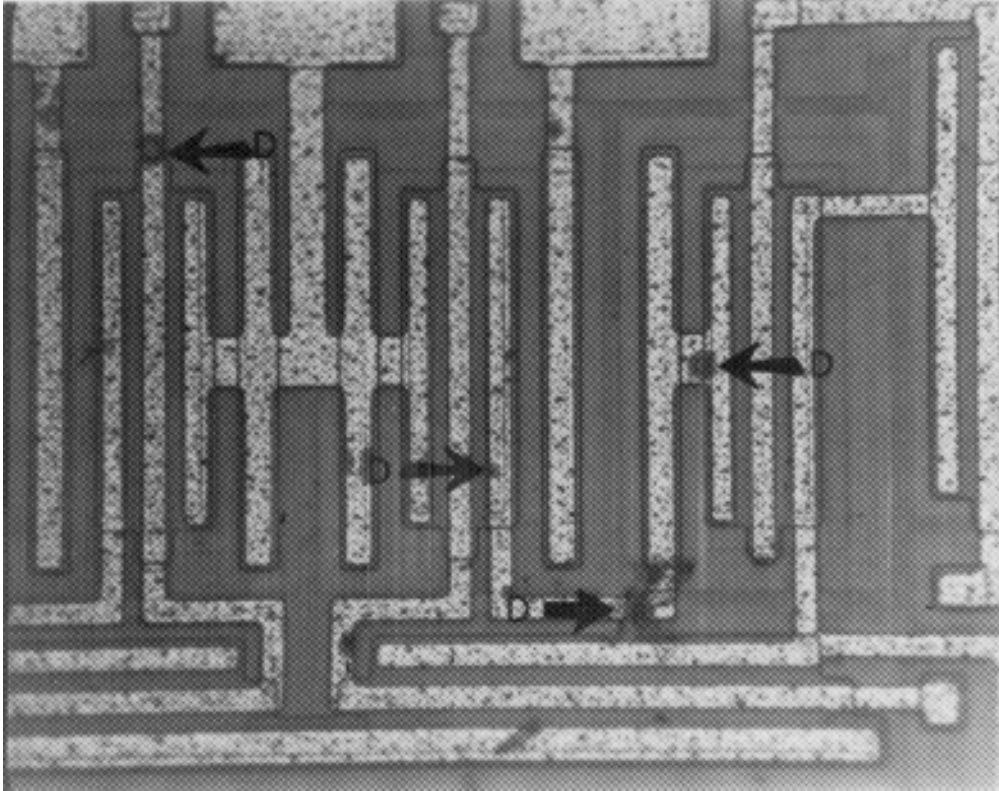


FIGURE 2021-7. Etched device exhibiting category D defects
pinholes in glass over aluminum.