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AEROSPACE MATERIAL SPECIFICATION

AMS 2535

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Revised

COATING, VAPOR DEPOSITED POLY-MONOCHLORO-PARA-XYLYLENE
For Microcircuits

1. SCOPE:

1.1 Purpose: This specification covers requirements for poly-monochloro-para-xylylene coatings.

1.2 Application: Primarily for use as a secondary moisture barrier coating on hybrid microcircuit substrates and on active monolithic devices. Additionally, the coating immobilizes undesirable particles remaining in sealed microcircuits and enhances to some degree the strength of fine wire interconnections.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2825 - Material Safety Data Sheets
AMS 3871 - Ceramic Sheet, Glazed 95% Alumina Base
AMS 2517 - Dimer, Dichloro 2,2 Para-Cyclophane

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM D3359 - Measuring Adhesion by Tape Test
ASTM E252 - Thickness of Thin Foil and Film by Weighing

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Material: The coating shall be vapor-deposited poly-monochloro-para-xylylene polymer.

3.2 Equipment:

3.2.1 Coating Chamber: Equipment used for the deposition of poly-monochloro-para-xylylene films shall consist of a closed system (Fig. 1) capable of maintaining the necessary zone-contolled pressures and temperatures which will produce coatings conforming to the requirements of 3.5.

3.2.2 Fixtures: Fixtures shall be designed to ensure that surfaces which require coating are not covered by the holding devices. Masking gaskets shall be adequate to prevent coating on specified surfaces and shall not damage or distort the surfaces being protected. In general, the opening in the fixture shall be as large as practical so as not to impede deposition flow and uniformity of coating. Typical fixturing for holding microcircuits during coating various configurations is shown in Fig. 2. When required, fixtures shall provide a mechanism for "shorting out" of microcircuit leads to prevent damage to sensitive devices as a result of electrostatic discharge.

3.3 Preparation:

3.3.1 Preparation for Lidded Microcircuits: Microcircuits which are to be coated through a hole in the lid or cover shall be prepared in the following manner: The hole in the lid or cover shall be established prior to lid attachment by drilling from the inside surface or by punching a hole from the outside surface consistent with the information presented in Fig. 3. The edge produced by the hole and the inside surface of the lid shall be sharp and free of burrs. Prior to making the hole in the lid, pretin an area on the outside surface of the lid where the hole will be located. This will facilitate subsequent solder sealing of the lid after completion of the coating operation.

3.3.2 Handling Microcircuits: Precautions shall be used in handling microcircuits to ensure that leads are not displaced or broken and that uncovered substrates are not touched or contaminated. Microcircuits which contain devices which are subject to electrostatic discharge damage shall be handled at all times by persons who are properly electrically grounded and only on approved work stations equipped to prevent static discharge damage to sensitive active devices.

3.3.3 Cleaning: Pre-cleaning of microcircuits shall be done by the microcircuit fabricator and the cleaned assembly shall be shipped to the coater in a suitable protective container. Any subsequent solvent or plasma cleaning operation performed by the coating vendor shall be used only with the permission and written approval of the purchaser. Cleaned microcircuits shall be handled only in laminar flow booths or under clean room conditions. This applies to all handling prior to final hermetic sealing.

3.3.4 Masking: In addition to the masking provided by the fixture and gasketing, additional masking shall be provided as necessary to prevent coating of leads which are subsequently soldered to provide electrical connections. The use of reusable room temperature vulcanizing (RTV) silicone rubber molded boots or removable masking compounds is permissible.

3.3.5 Adhesion Promoter Application: Unless otherwise specified, an adhesion promoter approved by purchaser shall be applied to surfaces to be coated. If solvents are used in the application of an adhesion promoter, they shall be of a purity consistent with that used for cleaning semiconductors and shall not contribute ionic species to the surface of active devices.

3.4 Procedure:

3.4.1 Place the microcircuits in a fixture consistent with the device configuration to be coated (Fig. 2). Fixtures and gasket surfaces which contact the microcircuit shall be free of parylene film left from prior deposition runs.

3.4.2 Uniformly locate not less than three witness specimens with each load of parts for coating. The specimens shall be similar to actual devices being coated but need not have components in place. In order to satisfy preproduction test requirements and specific acceptance test requirements, the addition of foil witness substrates may be required in addition to the hardware specimens.

3.4.2.1 If witness specimens are representative of "through hole" coating prelidded devices, the lids shall not be welded or soldered in place but shall be assembled using a low out-gassing adhesive such as a two-part epoxy. Prior to bonding the lid to the substrate assembly, coat the inside top surface of the lid with an extremely thin film of diffusion pump oil or other low vapor pressure (less than 1.0 µm at 25°C) release agent, making sure surfaces to be epoxy bonded are not coated. These steps will simplify disassembly of the witness specimens after deposition and aid in removal of the parylene film from the lid inner surface, providing the specimens for determination of coating properties.

3.4.3 Carefully place the fixtures containing witness specimens and devices to be coated in the deposition chamber, using care to ensure that open devices are not damaged or contaminated.

3.4.4 Load a sufficient amount of dimer in the vaporizer section of coating apparatus and reduce the pressure of the system to a maximum of 10^{-2} torr (1.33 Pa).

3.4.5 Raise the temperature of the vaporizer to 100° - 200°C (212° - 390°F), making sure that the temperature used does not increase the pressure in the system more than 50 microns (50 µm).

3.4.6 The temperature in the deposition chamber shall be maintained at 25° - 40°C (77° - 104°F) during the deposition processing.

3.4.7 Establish a flow of vaporized dimer into the pyrolyzer section of the coating equipment which is maintained at 600° - 700°C (1100° - 1300°F). The dimer flow rate into the pyrolyzer shall be maintained at maximum rate of 3 g per min. for coating open microcircuit packages and 0.15 g per min. for lidded devices which are coated through a hole in the cover.

3.4.8 Continue the process until the pressure in the vaporizer chamber returns to approximately 10^{-2} torr (1.33 Pa), indicating completion of the coating operation, reduce the temperature in vaporizer and pyrolyzer sections of the coater, and gradually bring the pressure of the system to atmosphere. Remove the fixtures from the chamber and carefully remove the parts.

3.4.9 Remove additional masking materials from other surfaces of coated parts, if present. If water or solvents are used to remove the maskant, precautions shall be taken to ensure that none of the materials enter the open hole in the lid of covered assemblies.

3.5 Properties of Coating: The coating as applied shall conform to the following requirements:

3.5.1 Coating Thickness: Shall be 0.00015 - 0.00075 in. (3.8 - 19 µm), measured in accordance with 4.5.1.

3.5.2 Adhesion: No film removal shall result from testing witness specimens in accordance with 4.5.2. This requirement is not applicable if an adhesion promoter is not required.

3.6 Quality: The applied coating shall be clear, free from pin holes, cracks, scratches, or discontinuities resulting from foreign material on the surface prior to coating or from mechanical damage caused by handling. Slight cloudiness is acceptable if other property requirements are met.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The processing vendor shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.6. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the coating conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to the following requirements are classified as acceptance tests and shall be performed on each lot except that the test for adhesion shall not be conducted when an adhesion promoter is not required:

Requirement	Reference Paragraph
Thickness	3.5.1
Adhesion	3.5.2
Appearance	3.6
Workmanship	3.6

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of coated parts to a purchaser, when a change in material or processing, or both, requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be as follows:

4.3.1 For Acceptance Tests: Sufficient parts or specimens shall be taken from each lot to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three. A lot shall be all parts coated in a single vacuum chamber load.

4.3.1.1 When a statistical sampling plan and acceptance quality level (AQL) have been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1 and the report of 4.6 shall state that such plan was used.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and vendor.

4.4 Approval:

4.4.1 Sample coated parts shall be approved by purchaser before coated parts for production use are supplied, unless such approval be waived by purchaser. Results of tests on production coated parts shall be essentially equivalent to those on the approved sample parts.

4.4.2 Vendor shall use manufacturing procedures, processes, and methods of inspection on production parts which are essentially the same as those used on the approved sample parts. If necessary to make any change in equipment or in operating conditions of the process, vendor shall submit for reapproval of the process a statement of the proposed changes in processing and, when requested, sample coated parts. Production parts coated by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Thickness: Using film removed from foil witness strips or from the surface of actual parts which have been treated with a release agent (See 3.4.2.1), determine the thickness in accordance with ASTM E252. Uniformity of deposition permits using a weight factor for determining thickness of deposit. A 0.0001 in. (2.5 μm) thick film weighs 2.11 mg per sq in. (0.33 mg/cm^2). Other methods for determining thickness may be used if agreed upon by purchaser and vendor.

4.5.2 Adhesion: Specimens shall be prepared from AMS 3871 ceramic sheet approximately 1.5 x 50 x 50 mm (0.062 x 2 x 2 in.) or other material agreed upon by purchaser and vendor. The test specimens shall be cleaned by immersion in boiling isopropyl alcohol for approximately 15 minutes. Prior to parylene coating, specimens shall be vacuum baked for not less than 2 hr at 125°C ± 5 (260°F ± 9) at a pressure not greater than 10^{-2} torr (1.33 Pa). Allow the parts to cool to room temperature, apply the adhesion promoter, and place the specimens in the coating fixture. Test in accordance with ASTM D3359 except that the film shall not be cut. If ceramic specimens are used, the test shall be run on the unglazed surface, unless otherwise specified.

4.6 Reports: The processing vendor shall furnish with each shipment three copies of a report stating that the parts have been processed and tested in accordance with the requirements of this specification and that they conform to the acceptance requirements. This report shall include the purchase order number, AMS 2535, lot number, part number, and quantity. When material for coating parts is produced or purchased by the coating vendor, that vendor shall inspect each lot of material to determine conformance to the applicable requirements of AMS 2517 and shall include in the report either a statement that the material conforms or copies of laboratory reports showing the results of tests to determine conformance.

4.6.1 A material safety data sheet conforming to AMS 2825 or equivalent shall be supplied to each purchaser prior to, or concurrent with, the report of preproduction test results or, if preproduction testing be waived by purchaser, concurrent with the first shipment of coated parts for production use. Each request for modification of coating formulation shall be accompanied by a revised data sheet for the proposed formulation.

4.7 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the parts may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the parts represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Parts shall be handled and packaged in such a manner as will ensure that the physical characteristics and properties of the coating are preserved.

5.2 Packages of coated parts shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the coated parts to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.3 Coated parts shall be returned to purchaser in containers supplied by him, if available, or in accordance with special instructions from the purchaser. Precautions, such as requirements for dry atmosphere, evacuated shipping containers, or use of a desiccant shall be observed. Assemblies incorporating devices sensitive to damage due to electrostatic discharge shall be handled in accordance with procedures and in facilities which preclude electrostatic charge build-up and potential component electrical damage.

5.4 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.1 and 5.2 or 5.3 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Coating not conforming to this specification or to modifications authorized by purchaser will be subject to rejection.

8. NOTES:

8.1 Removal of the vapor deposited parylene coating is very difficult in that it is insoluble in all common solvents. Mechanical removal such as achieved by soda blasting or subjecting parts to electrical plasma removal techniques are the only methods available.

8.2 Dimensions and properties, other than temperatures, in inch/pound units are primary; dimensions and properties in SI units are shown as the approximate equivalents of the inch/pound units and are presented only for information.

8.3 For direct U.S. Military procurement, purchase documents should specify not less than the following:

Title, number, and date of this specification
Part number of part to be coated
Quantity of parts to be coated
Applicable level of packaging (See 5.4)

8.4 Coatings meeting the requirements of this specification have been classified under Federal Supply Classification (FSC) 5970.

This specification is under the jurisdiction of AMS Committee "B".