TECH TIP 13

EPOXY TECHNOLOGY

Surface Preparation

WHAT

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WHY

Properly preparing a surface for bonding can increase reliability by optimizing a substrates' ability to accept the adhesive.

Why Surface Preparation Is Important?

In adhesive bonding the epoxy is only one part of the equation. Each substrate that is being adhered to is often as important as the adhesive selection. Physical properties such as bond strength, conductivity, and bond reliability all hinge on the interface between substrate and adhesive. The adhesive-substrate interface is a sensitive equilibrium that can be upset by even the slightest contaminants. In preparing a surface for adhesive bonding users can increase reliability and productivity by optimizing the substrate's ability to accept the adhesive.

Cohesive and Adhesive Failure

In an ideal adhesive substrate system, the adhesive will fail cohesively. A cohesive failure occurs when the adhesive is left evenly on both surfaces of the substrates. For a non-adhesive example of cohesive failure, consider an Oreo® cookie that is twisted open and has filling on both sides. Cohesive failures are ideal in terms of surface preparation because they indicate that the adhesive is the limiting variable in the equation. When this happens, it suggests that the adhesive had a stronger grip to the surface than itself which shows a high degree of surface adhesion. Alternately, an adhesive failure occurs when the entire adhesive is preferentially left on one substrate and can be indicative of poor surface preparation. For example, an Oreo® thatis twisted open and all the filling is left on one side is an adhesive failure. Failure analysis and identification of adhesive or cohesive failure can be a good indication of the quality of surface preparation.

Mechanical and Chemical Bonding

It is a common misconception that the ability of an adhesive to bond hinges on how well it "sticks" to a surface. Bonding is far more complicated and can be broken down into two major types of bonding: mechanical and chemical bond. Chemical bonding is the formation of chemical bonds between the surface of the substrate and the surface of the adhesive. These are physical bonds created by a chemical reaction between the surface and the adhesive. Mechanical bonding, on the other hand, is the ability of the adhesive to grasp the nooks and crannies of a complex and irregular surface. Bonds are not formed, but the surface is held by the adhesive like molecular Velcro®. Both mechanical bonding and chemical bonding are critical to any substrate and adhesive interface.

Methods of Increasing Surface Adhesion

Optimal surface preparation is a two step process of solvent cleaning/abrasion, and chemical treatment.

1a. Solvent Cleaning: The most common type of surface preparation is a solvent wipe before bonding. This process removes surface contaminants and organic matter with an organic solvent. The most common and substrate independent solvents used are acetone and isopropyl alcohol (IPA). Both are relatively safe organic solvents that will remove a wide array of surface contamination. Surfaces should be wiped down with a clean cloth and allowed to fully dry.

1b. Abrasion: Another part of the cleaning process is abrasion. This further eliminates surface contaminates and oxide layers. Abrasion exposes a clean, uncontaminated surface and increases the roughness and irregularity of the surface. This allows for greater mechanical bonding due to the increase in surface area and creates a greater physical barrier to resist shear. Common intermediate cleaning processes include dry abrasion, wet abrasion, grit blasting, and detergent scrubs. This step should be followed by a solvent wipe as described in step 1a.surface for adhesive bonding users can increase reliability and productivity by optimizing the substrate's ability to accept the adhesive.

Methods of Increasing Surface Adhesion (Continued)

2. Chemical Treatment: A second step in surface preparation is chemical treatment with strong etching compounds. Once the surface has been fully cleaned and roughened, it is chemically altered to increase its ability to receive and hold adhesive. Chemical treatment is commonly a strong acid, or powerful solvent that has the ability to chemically react and change the surface chemistry of the substrate. Chemical treatments are substrate specific and should be performed only after ensuring proper chemical hygiene and reading all applicable MSDSs.

Surface Preparations of Common Substrates

Substrate	Cleaning/Abrasion	Chemical Treatment	Method
Aluminum, aluminum alloys	**Cleaning** Vapor degrease with chlorinated solvent **Abrasion** Detergent scrub	1 L DI water, 300g H_2SO_4, 60g $Na_2Cr_2O_7 \cdot 2H_2O$ 1.5g 2024 bare aluminum Dissolve the Al to "seed" the bath	• Etch in bath for 12-15 min at 150-160°F. • Spray in tap water immediately for 5 min with a DI water rinse. • Dry at 120-140°F and do not touch bonding surface. • Prime or bond within 16 hour.
Copper, copper alloys	**Cleaning** Immerse, spray or wipe with chlorinated solvent **Abrasion** surface with emery paper	15 pbw 42% aqueous $FeCl_2$ soln 30 pbw Conc. HNO_3 197 pbw DI water	• Immerse for 1-2 min at room temp. • Rinse in cold running DI water. • Dry immediately with air at room temp.
Gold, Platinum or Silver	**Cleaning** Vapor degrease with chlorinated solvent **Abrasion** Use fine-grit emery paper to remove any tarnish from bonding area for silver only. any tarnish from bonding area for silver only.	None	• Follow abrasion with cleaning step.
Nickel	**Cleaning** Vapor degrease with chlorinated solvent **Abrasion** Abrade surface with emery paper	Conc. HNO_3	• Immerse metal for 5 sec in conc. HNO_3 at room temp. • Rinse etched metal thoroughly in cold running DI water then air dry at 104°F.
Stainless Steel	**Cleaning** Vapor degrease with chlorinated solvent **Abrasion** Abrade surface with alumina grit paper	3.5 pbw $Na_2Cr_2O_7 \cdot 2H_2O$ 3.5 pbw DI water 200 pbw Conc. H_2SO_4	• Immerse in bath at 140-160°F for 15 min. • Scrub under cold water with a stiff bristle brush then rinse in DI water. • Dry in oven at 200°F for 10-15 min.
ABS or methyl pentene	**Cleaning** Vapor degrease with acetone **Abrasion** Abrade surface with alumina grit paper	26 pbw Conc. H_2SO_4 3 pbw $K_2Cr_2O_7$ 11 pbw DI water	• Etch at room temp. for 20 min. • Rinse in tapwater then DI water. • Dry in warm air.
Epoxy, phenolics	**Cleaning** Vapor degrease with chlorinated solvent **Abrasion** Abrade surface with emery paper	None	• Follow abrasion with cleaning step.
Polycarbonate	**Cleaning** Vapor degrease with methyl alcohol **Abrasion** Abrade surface with emery paper	None	• Follow abrasion with cleaning step.
Fluorocarbons	**Cleaning** Vapor degrease with acetone or MEK **Abrasion** Abrade surface with emery paper	23g Na(s) 128g Naphthalene 1 L THF Add Naph. to THF carefully, adding cubes of Na slowly while stirring. Let sit 16 hr at RT then stir 2 hrs.	• Immerse in the solution for 15 min at 77°F near exhaust ventilator. • Wash in acetone or MEK then in cold, DI water and dry thoroughly.
Polyethylene, polypropylene	**Cleaning** Vapor degrease with acetone or MEK	75 pbw $K_2Cr_2O_7$ 120 pbw DI water 1500 pbw H_2SO_4 Dissolve $K_2Cr_2O_7$ in water and stir in the H_2SO_4.	• Immerse in the solution for 60 min at 77°F. • Rinse in cold, running DI water. • Dry at room temperature.
Polyimide or polymethyl-methacrylate	**Cleaning** Vapor degrease with chlorinated solvent or methyl alcohol **Abrasion** Abrade surface with emery paper	None	• Follow abrasion with cleaning step.
Polyurethane	**Cleaning** Vapor degrease with methyl alcohol	None	None
Glass quartz (non optical)	**Cleaning** Vapor degrease with MEK **Abrasion** Abrade surface with fine grit paper	1 pbw CrO_3 4 pbw DI water	• Immerse 10-15 min at 77°F . • Wash well in running water. • Dry for 30 min at 210°F. • Apply adhesive while still hot.
Optical grade glass	**Cleaning** Vapor degrease in an ultrasonically agitated detergent bath	None	• Rinse thoroughly. • Dry <100°F.
Ceramics	**Cleaning** Vapor degrease with MEK **Abrasion** Abrade surface with emery paper	None	• Follow abrasion with cleaning step. • Evaporate the solvent.

REACH COMPLIANCE
RoHS COMPLIANT
MIL STD 883/5011 COMPLIANT
ISO 9001 COMPLIANT

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