Etching Ferrules to Prepare for Epoxy Bond

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Two Types of Bondline Failures

- Adhesive Failure
  - Bondline failure where all of the adhesive material remains with one of the substrates and the failure surface is very smooth
    - All of the adhesive material is stuck to the bamboo joint with little or none stuck inside the ferrule with a very smooth surface
  - Usually caused by poor surface preparation
    - Very common for Epoxy bondline failures
- Cohesive Failure
  - Bonline failure where the majority of the adhesive material remains intact on both substrates and failure surface is irregular
    - Ferrule separates from the joint and a significant amount of the adhesive material inside the ferrule as well as on the bamboo joint
  - Usually caused by exceeding adhesive material strength properties or bondline thickness

Methods of Surface Prep

- Goal of surface preparation
  - Increase the epoxy adhesive strength so that it can develop the full cohesive strength in the bondline
- Best to Worst surface preps
  - Surface etch and prime
  - **Surface etch**
  - Abrade and rigorous clean
  - Rigorous clean
  - Do nothing or light clean

Etching Materials

- Materials commonly used to etch printed circuit boards (PCBs)
  - **Ferric Chloride with a small amount of Hydrocloric Acid**
    - 35 – 45 % FeCl, <.5% HCl, 55-65% H2O
    - Easily purchsed in premixed form
    - Use gloves to prevent contact with skin
    - *Extreme* caution should be used if making from FeCl3 anhydrous (powder)
      - Generates a lot of heat
      - Dangerous fumes
  - Friendlier etchants that should work well as suggested by Mike Biondo
    - Hydrogen Peroxide with Hydrochloric Acid
      - 2:1
    - 60% Vinegar & 40% Hydrogen Peroxide
- De-Ionized or Distilled Water (DI Water)
- Denatured Alcohol (DNA)

Etching Process

- Rigorously clean inside of ferrule to remove all oils and grit
  - Dawn & Q-Tip
  - Then progress to DNA & Q-Tip
- Etch inside of ferrule
  - Q-Tip pulled down to adequate size
  - Dip Q-Tip in etchant
  - Coat inside of ferrule and continue to wipe for several seconds
    - Q-Tip will turn black from metal being etched off surface
  - Throw away Q-Tip and Repeat
  - Let set for ~ 1 min

Etching Process Continued

- Flush inside of ferrule with DI water and shake out
- Flush inside of ferrule with DNA
  - Isopropyl Alcohol would also work
- Air Dry
  - Can speed drying up with a heat gun on low or a hair dryer
- Ready to bond when dry

Comments

- Have used this method to etch Duronze (Copper/Aluminum) ferrules as well as Nickel/Silver (Copper/Nickel)
- I use U40 RodBond Epoxy
  - A little heat helps to seat the ferrule
- Without adequate surface prep, epoxy bonds between metal and bamboo can easily fail from temperature cycling
- Bamboo prep is accomplished with minimal scuffing with sand paper and DNA wipe
  - I often have varnish on ferrule station prior to ferrule installation