STRATASYS

ELECTROPLATING WITH FDM MASTERS

Time Required Cost Skill Level

By Rob Winker, Stratasys, Inc.

Applies to all FDM Materials

Supplies:

- Sandpaper (220 - 500)
- IPS Weld-on #3
- Wet Sandpaper (220 - 800)
- Primer Paint

Overview

Electroplating deposits a thin layer of metal on the surface of an FDM part. This metal coating can be both decorative and functional. For demonstration and mock-up, the coating gives the appearance of production metal or plated parts. For function, the electroplating offers a hard, wear-resistant surface with reflective properties.

With simple finishing techniques, FDM parts are ready for electroplating with alloys that include chromium, nickel, copper, silver and gold. Combining the material properties of FDM with those of a metal coating, the part has strength, durability and heat resistance that is ideal for functional applications.

Electroplating for increased durability

Electroplating not only enhances the look of a part but it also produces a hard, durable surface and dramatically increases the strength of an FDM part.

Electroplating causes a dramatic increases in strength (figure 1, 2 and 3). The FDM test bars were built both flat and on edge. The plating thickness was tested at both 0.005" (0.127mm) as well as 0.010" (0.254mm). The thickness of plating typically ranges from 0.0001-inch to 0.020 inch (0.0025mm-0.508mm). The FDM test bars were plated with a combination of nickel and copper, although typical metals used in plating also include chrome, brass, palladium, silver and gold.

Testing conducted by Aspen Research Corporation in St. Paul, MN, showed impressive increases in both the tensile and flexural strengths of FDM test bars (figure 1, 2 and 3). Depending on the coating thickness and test bar orientation the tensile strength increased 10 to 12 times that of a raw FDM test bar. The results of the flexural tests were even more substantial. They showed an increase of 21 to 24 times that of a raw FDM test bar.

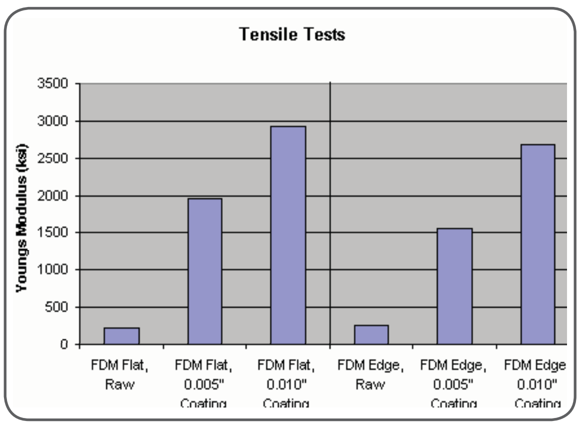

Figure 1: Tensile test results of fdm raw part flat vs edge - 0.005" and 0.010" coatings.

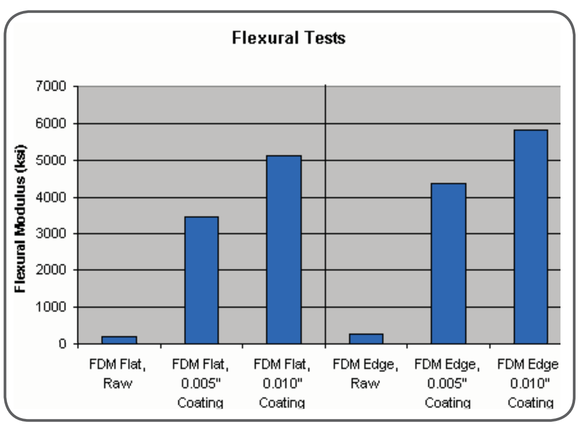

Figure 2: Flexural test results of fdm raw part: flat vs edge - 0.005"and 0.010" coatings.

	Tensile Tests			Flexural Tests		
	Stress (ksi)	Elongation at Break (%)	Young's Modulus (ksi)	Maximum Stress (ksi)	Flexural Strain at Max Load (%+D1)	Flexural Modulus (ksi)
FDM Flat, Raw	2.8	13.3	228.8	4.9	4.6	206.7
FDM Flat, 0.005" Coating	15.7	2.3	1956.4	43.9	2.3	3449.6
FDM Flat, 0.010" Coating	24.4	3.3	2931.1	66.8	2.5	5124.9
FDM Edge, Raw	3.3	25.6	258.4	6.3	4.7	267
FDM Edge, 0.005" Coating	14.7	3.2	1564	43.6	1.9	4366.2
FDM Edge, 0.010" Coating	26.1	3.5	2682	64.3	2.1	5828.3

Figure 3: Raw numbers for Tensile and Flexural tests.

Process

Consult with vendor on process specifics, estimate coating thickness, temperature exposed etc. Choose material and adjust a part accordingly to vendor specifications.

1. Adjust Cad file.

Offset surfaces in the CAD model to allow for the thickness of the electroplated material. If there are any critical dimensions, such as hole or boss diameters, they should be communicated to the electroplater so that these dimensions can be maintained throughout the electroplating process.

Electroplated parts can be either solid or sparse fill.

2. Build FDM part.

Materials that have been tested include; ABS-M30, ABS, ABS*plus*. While all other FDM materials may be suitable for electroplating, they have not been tested and verified at the time of publishing this document.

Figure 4: Sanding. Using appropriate grit sandpaper, remove FDM build layer lines.

3. Sand surfaces.

After removing support structures, sand the part to remove build layer lines and stepped areas. At this point, a coarse sanding is sufficient (figure 4). The smooth surfaces needed for electroplating will be addressed in the next few steps.

4. Seal surfaces.

The part must be sealed to prevent it from absorbing any of the electroplating solutions. There are three options for sealing the FDM part- vapor smoothing and solvent dipping, and painting (figure 5).

Recommended sealant method:

Material	Vapor Smoothing	Dipping Solvent	Painting
ABS (ABS, ABSi, ABSPlus, ABS-M30)	x	x	x
PC (PC, PCABS, PC ISO)		x	x

Figure 5: Recommended sealant method per FDM material

Option 1 - The first technique, vapor smoothing, exposes the FDM part to a vaporized solvent for 15 to 30 seconds. Vapor Smoothing has been tested on ABS, ABSplus ABS-M30, and ABSi.

Option 2 - The second technique, solvent dipping (figure 6), smooth the surface by submerging the FDM part in a chemical bath for approximately 15 seconds. The recommended solvent is methyl ethyl ketone (MEK), sold commercially as Weld-on #3. If this is not available, methylene chloride, also called dichloromethane (DCM), may be substituted.

Option 3 - The Third technique, painting, will seal the part as well as fill in the layer lines. Use a sandable primer and sand after each coat to eliminate any uneven surfaces. If painting is approved by the electroplater spray the part with the sandable primer and allow it to dry. Then, sand the part to the desired finish. Repeat as necessary. Note: Before applying primer, seek the advice of the electroplater. Primers can cause adverse reactions and contaminate the tanks of electroplating solutions.

If FDM master is painted the electroplater will need to apply a “spray” conductive coating instead of using the traditional electro-less nickel bath.

Skip to step 7. Electroplating if using Option 3.

Figure 6: Sealing. Seal the part’s surfaces by dipping in solvent.

5. Dry part.

There will be solvent trapped in the part after the sealing process. If electroplating is attempted before the solvent has completely evaporated, the plating material will bubble and peel off of the part.

Electroplated Part : Finished part with functional and decorative copper-nickel-chromium plating.

Allowing the part to dry for a minimum of 18 hours will ensure that no solvent remains. However, the drying time may take longer since it is dependent on the part's geometry. To accelerate the process, the part can be heated overnight in an oven set to 110 °F (43 °C).

6. Re-sand surfaces.

Sand away any remaining layer lines or stepped surfaces and repeat steps four and five. Repeat the sealing and sanding steps until the desired surface finish is achieved (figure 4). Electroplating will not hide any surface defects so minor flaws must be buffed out of the copper coating before the nickel coating is applied.

7. Electroplating

Send part to the approved vendor for electroplating. Coating Thicknesses, verify specifications with vendor.

Copper layer thickness guidelines:
0.005 - 0.010 inches (0.127-0.254 mm) thick.

Nickel layer thickness guidelines
0.001 inches (0254mm) thick.

Chromium (Optional) layer thickness guideline:
0.001 of an inch (.0254mm) thick.

Suppliers

Supplies are readily available at hardware stores, hobby shops and industrial supply companies.

More Information

1. Contact a Stratasys Applications Engineer by calling 800-937-3010 or visit www.stratasys.com for information.

2. For FDM electroplating services, contact Repliform Inc. at 410-242-5110 or visit www.repliform.com

For more information about Stratasys systems and materials, contact your representative at +1 888.480.3548 or visit www.stratasys.com

Stratasys Inc.
7665 Commerce Way
Eden Prairie, MN 55344-2080
+1 888 480 3548 (US Toll Free)
+1 952 937 3000
+1 952 937 0070 (Fax)
www.stratasys.com
info@stratasys.com

Stratasys GmbH
Weismüllerstrasse 27
60314 Frankfurt am Main
Germany
+49 69 420 9943 0 (Tel)
+49 69 420 9943 33 (Fax)
europe@stratasys.com

STRATASYS®
Real Parts