White Out

Putting a rhodium plating solution to the test

***Editor's Note:** In addition to showcasing the newest products in the industry,* MJSA Journal *occasionally likes to have products tested and reviewed for our readers. This month, we asked Neil Bell at Red Sky Plating in Albuquerque, New Mexico, to test the Superbrite rhodium plating solution from Baltimore-based Cohler Enterprises Inc., which the company promotes as being suitable for use at room temperature, capable of plating longer without burning, and designed to produce a bright, white mirror finish. Bell explains the testing procedure they followed as well as the results of their tests below.*

The Tests

To determine how the Superbrite rhodium plating solution should perform for a jeweler, we chose to use a Hull cell testing device. A Hull cell is a small plating vat that has a particular trapezoidal shape. Used by electroplaters for more than 70 years, these cells allow us to easily change a variable, such as temperature or voltage, and observe the results at various current densities on a single panel. The test panel is placed in the Hull cell at an extreme angle, with the left edge very close to the anode and the right edge further away from the anode. In this way we can get readings at very high, mid-range, and low current densities. We can then extrapolate those readings to specific areas on an item of jewelry.

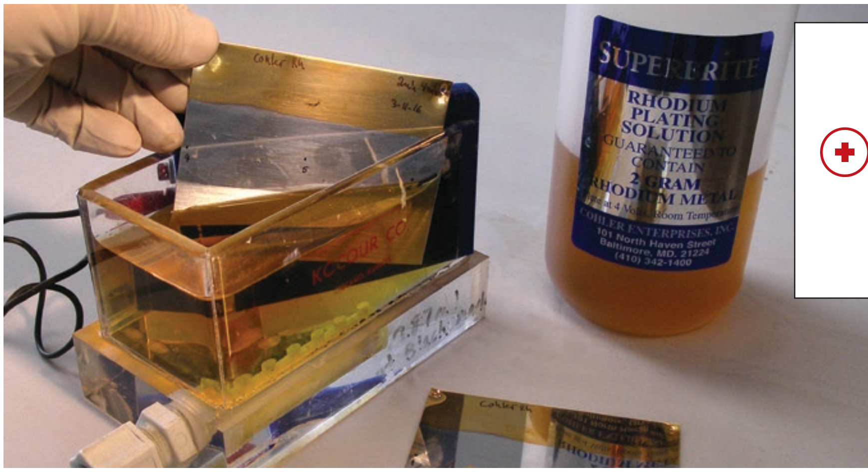
We prepared four 3-inch-by-4-inch panels of mirror-bright brass sheet that is specially made for use in a Hull cell. Although most rhodium plating is used on white gold, we plated the panels with yellow gold so we could see how well the rhodium covered the gold substrate. We also added a satin finish area so we could see if the solution had any impact on the texture.

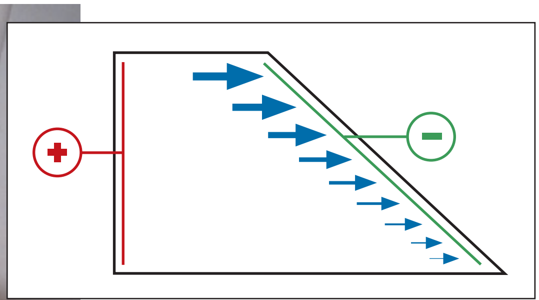
Following the solution's instructions, we plated the panels at 4 volts, generating 3.4 amps of current. The instructions indicated that the solution could be applied for one, two, or three minutes and that it should be used at room temperature. Given that, we plated two sheets for one minute—one at 70°F, the other at 75°F (since a user's room temperature is likely to vary)—then plated the other two sheets for two and three minutes, respectively, both at 75°F.

Initial Results

After consistent color and ease of use, most craftspeople want to know that the rhodium finish will give the customer long wear, so plating thickness is an important consideration. To measure this, we used x-ray fluorescence at three current densities to see how the variables in plating (time, temperature, and amperage) affected the rhodium deposit. On jewelry, the higher current density (1.8 amps on the panel, which leaves a thicker deposit) will typically be applied to the extreme ends of pointed spots, such as the end of prongs or the point of a star shape. The lower current density (0.03 amps on the panel) will be in recessed areas, such as the inside of stone settings. And the middle current density (0.3 amps) will cover most of the surface of a jewelry item with this plating solution.

The results of the tests are featured in the chart on page 50. The high current density on the panels represents the tops of prongs and will have a thickness from





We used Hull cells to test the Superbrite plating solution, which allow us to change variables, such as temperature or voltage, and observe the results at various current densities on a single panel.

5 to 16 micro-inches, depending on the temperature and how long the item is plated. Since the mid-range of the current density represents the thickness we are likely to see on most of the item, a jeweler will want to plate for 3 minutes to get about 5.5 micro-inches of thickness for good wear. The feedback that we have from our customers is that about 4 micro-inches of thickness of rhodium provides them with adequate wear life.

A Comparison

After conducting the tests at the recommended voltage and time, we did some additional tests at a lower voltage, at a higher voltage (to see when "burning" might first occur), and for longer than the recommended time. We also ran some panels with a generic plating solution (which we will call Brand X) for comparison. The three additional Superbrite panels were run at room temperature (75°F), and the three Brand X panels were run at the recommended temperature for that brand, 110°F.

Panel 5 was plated with Superbrite at only 2 volts, which is half the recommended voltage. We found that we still saw good, bright rhodium coverage, even at the low end of the current density and with only about 1 micro-inch thickness. This implies that a jeweler will get a good rhodium plate into recessed areas even at well below the manufacturer's recommendation.

For panel 6, we ramped up the voltage from 4 volts to 10 volts (the limit of the rectifier and well above the recommended voltage for Superbrite). Even at 10 volts and 5.3 amps per square inch, there was no evidence of burning—a nice attribute. (Compare this with panel 10, below.)

Panel 7 was plated at the recommended 4 volts but well beyond the time the manufacturer suggests. We started to see haze (a cloudy deposit) at 4.5 minutes on the high current density area. The haze grew to about the halfway point on the panel (2 inches) in the 7-minute duration of the test. While the plating solution starts producing haze at about 27 micro-inches of rhodium thickness and at 4.5 minutes, this should not be a problem when operating within the manufacturer's recommended parameters.

Panels 8 and 9 were plated with Brand X solution for one minute. We included these panels because we were interested in the difference in the rate of deposit between this brand and the Superbrite solution. We also used them to compare the color of the plating. The mid-range of the first two Superbrite panels (both for one minute) was somewhat lower in thickness even at the higher voltage: 4 volts as opposed to 2 and 3.5 volts. The jeweler would need to plate for a little longer to reach a desired thickness with the Superbrite solution.

We ran panel 10 in the Brand X at the recommended 110°F and we ramped the voltage up until, at 6 volts, we saw burning on the high current density area of the panel. This is well below the 10 volts we stopped at with the Superbrite solution, which exhibited no burning.

Appearance

With the exceptions of panel 7 (which we intentionally plated until it was hazy) and panel 10 (which we burned), the appearance of all the plated panels is uniform and bright across current densities, from high to low. The Superbrite rhodium also maintained the texture of the satin areas

Test Results

Current Density	Plating Thickness	Current Density	Plating Thickness
Panel 1: One Minute at 70°F		**Panel 6: One Minute at 10 Volts**	
0.03 amps per square inch	1.19 micro-inches	0.05 amps per square inch	4.95 micro-inches
0.3 amps per square inch	2.66 micro-inches	0.94 amps per square inch	10.9 micro-inches
1.8 amps per square inch	4.88 micro-inches	5.3 amps per square inch	26.8 micro-inches
Panel 2: One Minute at 75°F		**Panel 7: Seven Minutes at 4 Volts**	
0.03 amps per square inch	1.67 micro-inches	0.02 amps per square inch	10.2 micro-inches
0.3 amps per square inch	3.04 micro-inches	0.34 amps per square inch	17.9 micro-inches
1.8 amps per square inch	7.30 micro-inches	1.9 amps per square inch	41.5 micro-inches
Panel 3: Two Minutes at 75°F		**Panel 8: Brand X One Minute at 2 Volts**	
0.03 amps per square inch	2.51 micro-inches	0.003 amps per square inch	1.11 micro-inches
0.3 amps per square inch	5.58 micro-inches	0.05 amps per square inch	3.17 micro-inches
1.8 amps per square inch	12.3 micro-inches	0.27 amps per square inch	4.72 micro-inches
Panel 4: Three Minutes at 75°F		**Panel 9: Brand X One Minute at 3.5 Volts**	
0.03 amps per square inch	3.67 micro-inches	0.008 amps per square inch	1.67 micro-inches
0.3 amps per square inch	7.09 micro-inches	0.13 amps per square inch	4.64 micro-inches
1.8 amps per square inch	16.5 micro-inches	0.74 amps per square inch	8.37 micro-inches
Panel 5: One Minute at 2 Volts		**Panel 10: Brand X One Minute at 6 Volts**	
0.002 amps per square inch	0.95 micro-inches	0.02 amps per square inch	3.7 micro-inches
0.04 amps per square inch	1.58 micro-inches	0.32 amps per square inch	10.13 micro-inches
0.2 amps per square inch	2.35 micro-inches	1.8 amps per square inch	19.48 micro-inches

on the test panels. (With some plating solutions you see leveling on a satin finish as the solution fills in the valleys on the surface. We did not detect that here.) We examined the panels at our inspection table under daylight fluorescence lighting and, after comparing the Superbrite panels to the Brand X panels for color, we did not detect any difference. All of the panels had a uniform bright-white rhodium color.

Conclusion

Superbrite has some nice attributes that are different from the generally used rhodium solution: This is a very forgiving plating solution that can be run both at much higher and much lower than recommended voltages without causing any harm. Its ability to operate well at room temperature is valuable because it will always be ready to use on the jeweler's bench. It deposits at a little slower rate but this may be a small sacrifice in light of the advantages the Superbrite solution provides.

Overall, we've found this to be a very good product that has some unique characteristics that a jeweler should find useful. ◆

***Supplier's Note:** We asked Jewelcraft and Stuller Inc. to perform testing on the Superbrite rhodium as we were developing the new line. Jewelcraft plated thousands of jewelry pieces for us and found the plating results to be consistently bright white from start to finish using a variety of plating ranges at room temperature. Stuller was able to perform luminance testing to confirm what the plated results showed to the naked eye. Most jewelers are plating at 30 seconds and achieving beautiful results.*