

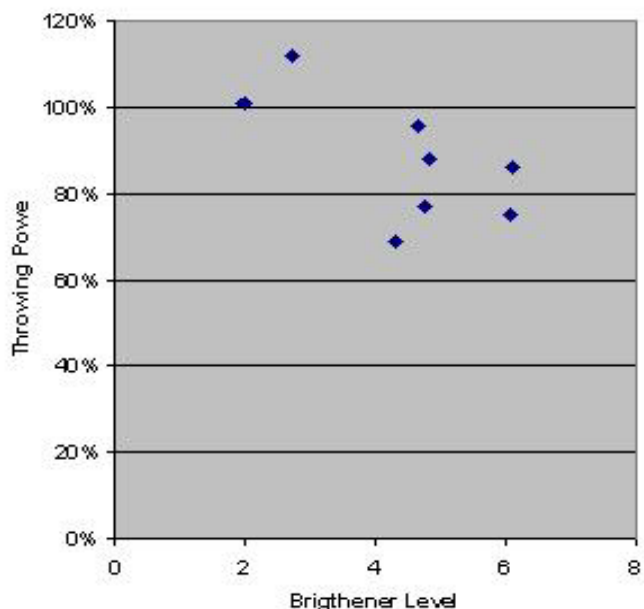
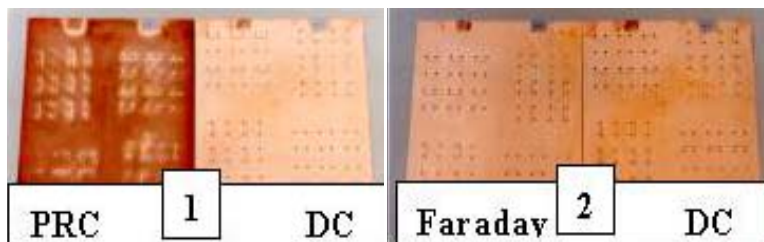
Copper Plating without Brighteners using the *Faradayic* Process

Objective:

This project demonstrated the feasibility of using the patented *Faradayic* Process to deposit copper without the need for brighteners in a copper plating bath for electronics applications.

Summary:

The *Faradayic* Process used correctly can eliminate the need for brighteners in a copper plating bath for electronics applications. The boards plated using the adapted pulse reverse current (PRC) waveform developed for one vendor's proprietary additive chemistry were literally "burnt" as compared to the DC process, even at a variety of brightener concentration levels. The boards plated using the *Faradayic* Process tuned to the brightener chemistry produced a deposit comparable to the DC condition. Furthermore, as the brightener level decreased, the throwing power increased. This example shows that simply using a PRC waveform developed for one chemistry in another chemistry won't work because small changes in brightener species are exponentially affected by the electric field. The tunability of the *Faradayic* Process allows the brighteners to be eliminated, and throwing power to be enhanced by selecting the correct process parameters.



Background:

The patented *Faradayic* Process is an electrochemical manufacturing technique that utilizes a controlled electric field to electrodeposit a material of interest. Since the *Faradayic* Process is electrically mediated, it does not require small amounts of proprietary chemicals to facilitate the metal deposition as needed in conventional electrochemical processes (e.g. DC). The material deposition rate is determined by the applied electric field, which is user-defined and computer controlled. This provides the means for precise control of the length of the process, the total material deposited and the properties of the deposit.

The *Faradayic* Process technology illustrated above is protected by a substantial patent portfolio including issued, allowed, and pending patent actions.