Ormet Circuits, Inc.

Oxidation Resistance of Processed Ormet Paste

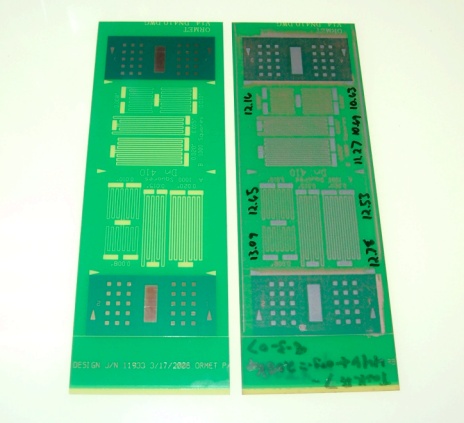
Task Summary: Characterize the oxidation behaviors of processed Ormet paste in exposure conditions such as high humidity, high temperature and cleaning solutions.

Background: Processing of Ormet 7001 converts the discrete metal particles in the material into an alloyed metal network. It is therefore anticipated that processed Ormet will maintain a low and stable resistance even after exposure to extreme environments.

Purpose: The purpose of this task is to determine the effects of adverse environments on the performance of cured Ormet 7001 paste.

Scope: The activities in this task were designed to accelerate the effects of high humidity, solvent exposure and high heat exposure by fully immersing the samples in the adverse environment for several weeks. Periodic resistance measurements were made to determine the environmental effects on the samples.

Activities: The test vehicle for this task was OCI's standard resistance test card DN410 with 8, 10, 15 and 20 mil serpentine trenches defined in an applied photopolymer. The underlying substrate material is FR4. The Ormet 7001 is doctor-bladed into the trenches, the test cards are dried at 95°C and then the paste is cured in a lamination press at 190°C at 300 psi for 15 minutes.



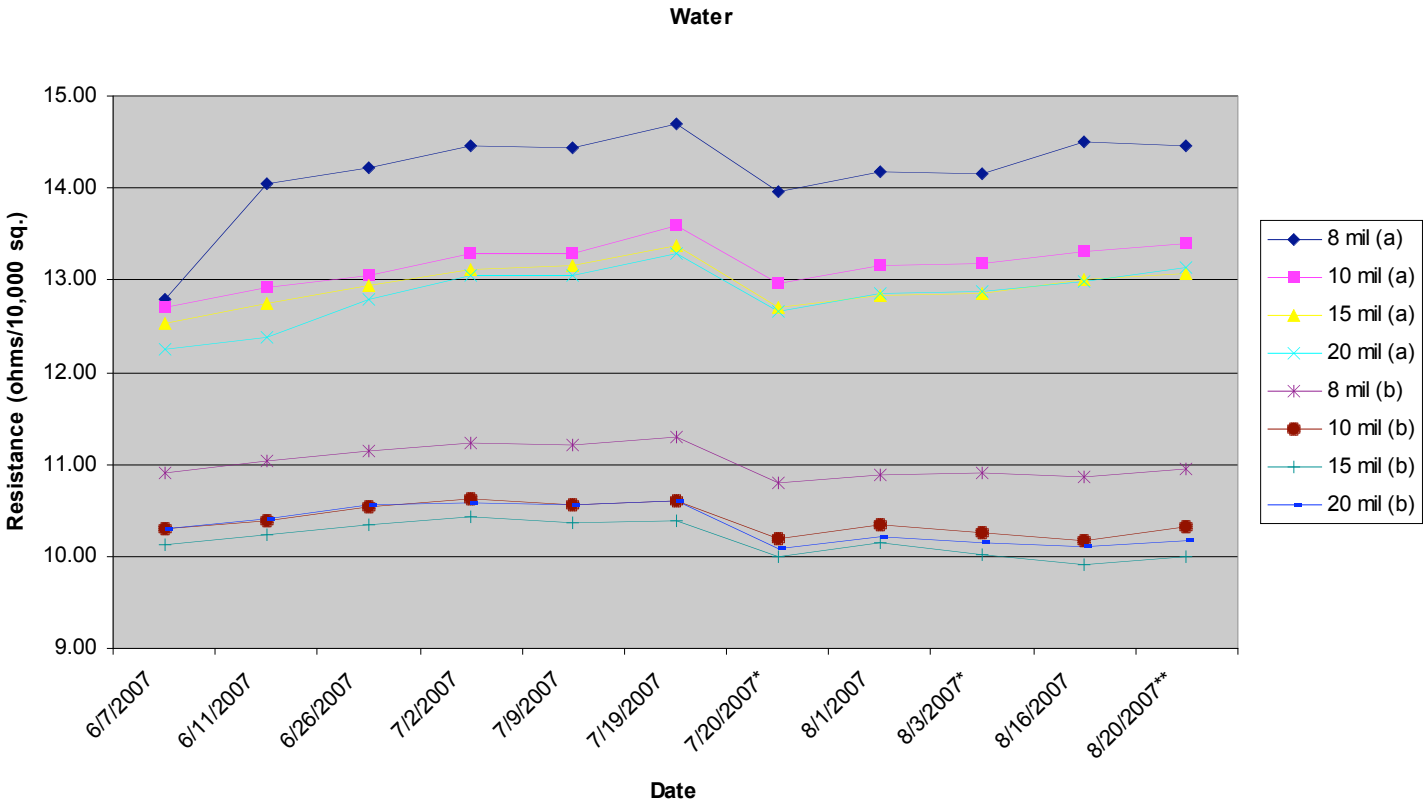
OCI DN410 resistance test card

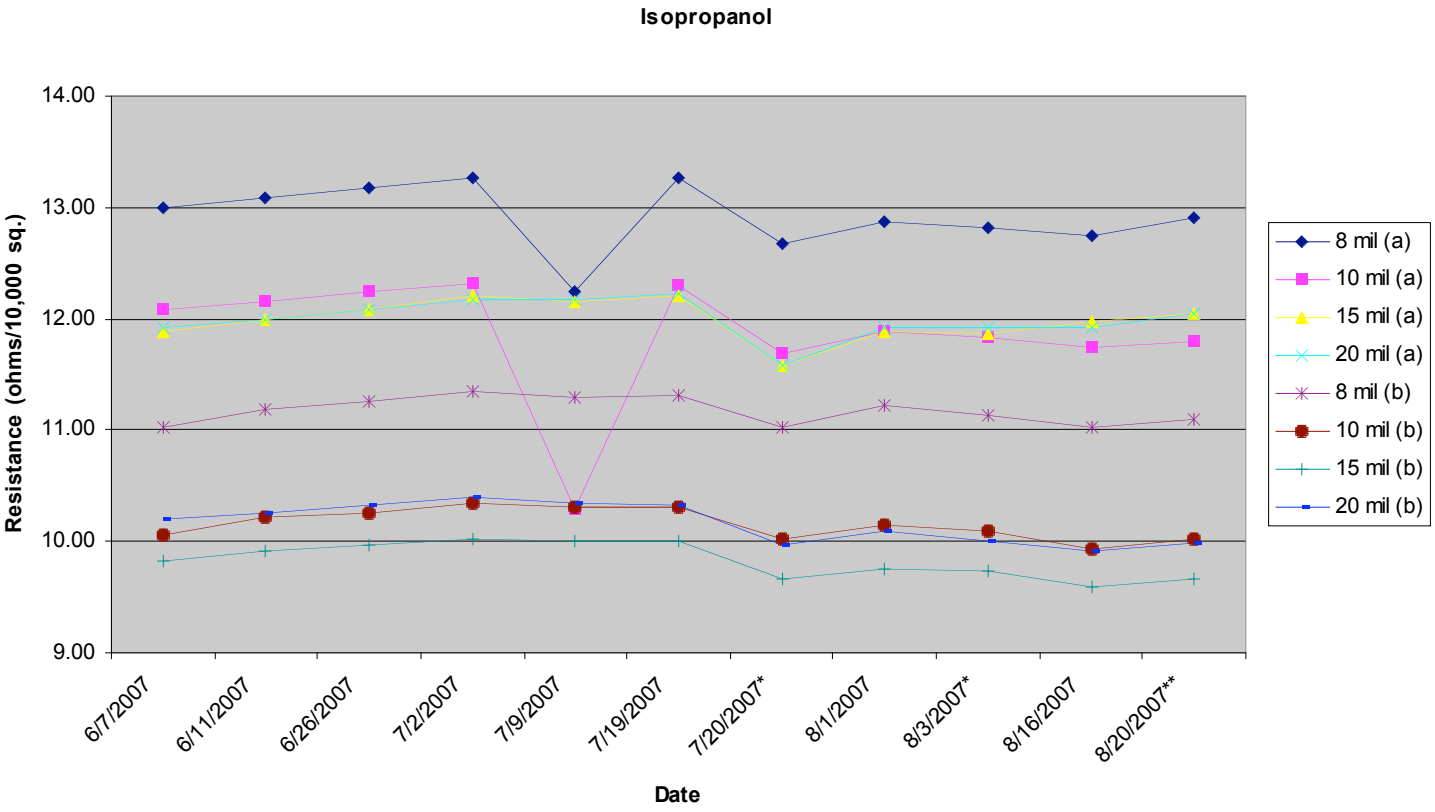
A tap water tank and an isopropanol tank were created by filling glass baking dishes to a depth of about one inch. The isopropanol tank was covered to prevent evaporation. The water tank was left open and was replenished periodically.

One processed DN410 card was labeled for each tank. Initial resistance measurements were performed on all eight serpentine patterns of each test card and the results of those measurements were recorded in the log. The samples were then submerged in the tanks for 38 days. Resistance measurements were taken, with decreasing frequency, over the period that the samples were submerged. To take resistance measurements, the samples were removed from the tanks and blotted dry. Immediately after the measurements were taken, the samples were returned to their respective tanks.

After 38 days, the samples were removed from their tanks and baked for 24 hours at 100C. Resistance measurements were made and then the samples were returned to their respective tanks for 12 days. Resistance measurements were made after the 12 days and the samples were subjected to another 24-hour bake cycle (100°C). A set of resistance measurements was made after this second bake cycle, after two additional weeks of submersion, and after four days at 100°C.

All of the resistance measurements are provided in graphical form below.





Conclusion: As anticipated, the alloyed metal network that is formed when Ormet 7001 is processed is stable in environmentally adverse conditions. After over two months of full submersion in water and isopropanol and three 100°C bake cycles over 24 hours in duration each, the resistance of the traces never changed by more than 10 percent.
It is interesting to note that the small change in resistance observed over the long submersion was reversed by the first bake cycle. The mechanism for this resistance recovery is not known; however, it seems likely that the test boards had swollen as they became saturated and the mechanical strain caused by that swelling was relieved by baking the test boards. This does not, however, explain why the same effect was not observed in subsequent bake cycles. A possible explanation is that the effect is not as evident because the period of submersion was shorter, or possibly because the substrate was less susceptible to swelling after the initial bake cycle.