Evaluation of anodized aluminum for potential use as interposer for test socket industry

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INTRODUCTION

Test sockets are used to ensure proper connections in circuit boards and reduce early component failure. As test sockets must be long-lasting and of the highest quality, they tend to be quite expensive.

A major cost in the fabrication of these devices is the interposer, an interface layer that reroutes one connection to another. The interposer must have high resistivity with low loss, a smooth surface finish, high strength, resistance to chemicals involved in the process, and be extremely thin. Currently, the most common materials used for interposer are plastics, such as Torlon, Semitron, and PEEK. While these satisfy the requirements for test sockets, finding a less expensive, alternative material would be preferable.

We propose that aluminum could serve as an interposer, given its ductility, low density, and electrical and thermal conductivity. Anodizing the aluminum would produce a ceramic-like oxide layer that would produce high resistivity and resistance to chemicals, while still remaining affordable.

In a previous research project, Will Allen experimented with the anodizing process of aluminum alloy 6061. Will tested which length of anodization time produced the thinnest oxide layer with high resistivity, settling on a process within a ten-minute time frame. [3] The samples he anodized with this process were used in the current study.

While we have shown that the anodized aluminum exhibits the desired resistance, we need to test if repeated thermal cycling will compromise the oxide layer. Test sockets operate between 125-175°C, meaning the material is subjected to frequent temperature changes. Should the oxide layer develop cracks or other critical defects, the aluminum would lose its high resistivity, causing the test socket to fail.

In this study, we will subject anodized aluminum samples to repeated thermal cycling between 22-150°C in increments of 500 cycles, up to 5,000 cycles. After every 500 cycles, we will examine the oxide layer for any critical defects. If no defects are found, then we suggest that anodized aluminum could be use as interposer material.

METHODS

To establish initial conditions, we examined anodized aluminum samples, prepared in a previous research project, under a scanning electron microscope. Pictures at different locations and magnification were recorded for later comparison.

To imitate the thermal cycling of test socket, we designed the setup below that would allow the samples to cool to room temperature between heating. Since the metal requires more time to cool than to heat, a motor rotates samples over a heating element, allowing the metal to warm up over a short period of time while the remainder of its rotation could be spent cooling.

Ten rotations were timed, giving an average of two minutes per cycle. Using this to calculate the time necessary for 500 cycles, we ran the thermal cycling for 16 hours, 40 minutes.

After the two samples were ready, we went back to the scanning electron microscope and took pictures at approximately the same locations and magnifications as before, looking for any changes in the oxide surface, especially cracks or other defects.

RESULTS

After 500 cycles, we found that the anodized aluminum surfaces showed no noticeable difference at relatively high magnification under the scanning electron microscope. Shallow pits and tracks appear both before and after thermal cycling.

CONCLUSIONS

So far, this study has shown that anodized aluminum alloy 6061 withstands at least 500 thermal cycles without resulting in critical defects that would compromise the oxide layer, and therefore reduce resistivity and its viability as an alternative interposer material.

We plan to subject these samples to further thermal cycling in increments of 500 cycles, up to a total of 5,000 cycles. We can more conclusively judge anodized aluminum’s viability when extensive testing has been completed.

BIBLIOGRAPHY

3 Allen, Will, Dominique Tan-Ng, Lucas Machado, and Boon-Chai Ng. Evaluation of Anodized Aluminum for Potential Use as an Interposer for the Test Socket Industry.