ENGINEERING

The Design and Manufacturing of an Environmental Chamber to Test Microelectronic Devices

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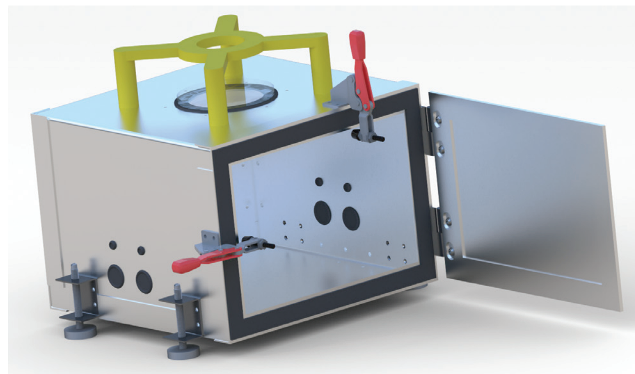
As further studies are undertaken to improve the capabilities of microelectronics, methods of testing need to be perfected as well. One method of testing, "accelerated aging," exposes microelectronics to high temperatures and humidities to gather and extrapolate data about their lifespan, to better inform end user expectations and potentially help produce ideas for device improvement. Another microelectronic reliability issue of importance is electromigration. Electromigration can create voids in electronic traces, leading to interrupted circuits or electrical shorts, breaking microelectronics. Electromigration is well understood at larger scales, but as the scale of components approaches less than ten nanometers, current theory becomes less applicable.

The goal of this project was to design, build, and test an environmental chamber capable of controlling internal humidity and temperature for advancing current understanding of microelectronic degradation. The main metrics to optimize were size (benchtop), cost, and ease-of-use. Data logging and video recording of samples was also to be included.

The chamber was designed to be laser cut out of a sheet of 3000 series aluminum and then bent on a brake into a box. Additional structural support was provided using aluminum extrusions, and the chamber was sealed using epoxy. A hinged access door allows for microelectronic device samples to be placed and retrieved quickly. The heat source is a 3D printer heated bed, controlled via Arduino, which also logs internal air temperature and humidity. A borosilicate glass window on the top allows for video recording of testing.

Research advisor Ryan Wagner writes: "This project is to design, build, and test an environmental chamber for characterizing microelectronic devices at controlled temperature and humidity. It will be used to test key failure mechanisms such as electromigration and electrochemical migration on next-generation rigid and flexible transistors, capacitors, displays, sensors, and other industrially important devices."



Environmental chamber awaiting sample to test.

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