A Microscale Sputter-Ion Pump and Harsh Environment Multi-Plasma Microsystem

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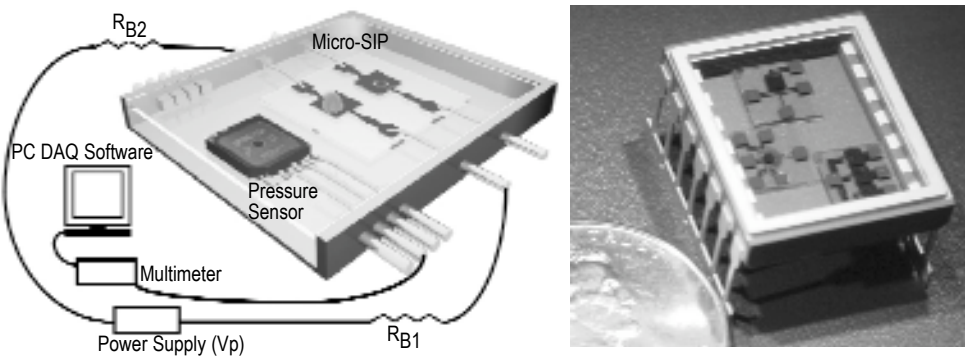

Left – Schematic of a microscale sputter-ion pump in a package, Right – photograph of a harsh environment gas sensor which operates up to 200°C.

This project is developing microdischarge-based devices to control the environments in microscale packages and to detect gases in harsh environments. Microscale sputter-ion pumps (micro-SIPs) are used to control pressure, humidity, and gas composition inside micropackages. Micro-SIPs are typically fabricated by patterning thin-film titanium electrodes and operated by sputtering these electrodes through the application of high voltages. The resulting microplasmas cause the titanium to bond to gases in the environment, and these new molecules fall to the substrate surface. This effectively removes them. Removing a large number of molecules allows a user to control the pressure inside a sealed cavity, while selectively removing nitrogen and oxygen in an inert gas environment allows a user to control the purity of an environment. Micro-SIPs have reduced the pressure in a sealed cavity by 168Torr. A system for gas-phase chemical detection in harsh environments has been developed that utilizes three microplasma-based devices: the micro-SIP as a gas purifier; a pressure sensor; and a discharge emission chemical sensor. The gas-purifying micro-SIP has achieved a 56.5x reduction in nitrogen concentration relative to helium. This purification enhances the ability to detect trace amounts of gases and has demonstrated a spectral enhancement of 8x at 200°C for carbon line emission intensity. This project is supported by the Engineering Research Centers Program of the National Science Foundation under award number EEC-9986866.