Physical Sciences

Compensating for Effects of Humidity on Electronic Noses

Corrections are derived from outputs of separate humidity and temperature sensors.

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A method of compensating for the effects of humidity on the readouts of electronic noses has been devised and tested. The method is especially appropriate for use in environments in which humidity is not or cannot be controlled — for example, in the vicinity of a chemical spill, which can be accompanied by large local changes in humidity.

Heretofore, it has been common practice to treat water vapor as merely another analyte, the concentration of which is determined, along with that of the other analytes, in a computational process based on deconvolution. This practice works well, but leaves room for improvement: changes in humidity can give rise to large changes in electronic-nose responses. If corrections for humidity are not made, the large humidity-induced responses may swamp smaller responses associated with low concentrations of analytes.

The present method offers an improvement. The underlying concept is simple: One augments an electronic nose with a separate humidity and a separate temperature sensor. The outputs of the humidity and temperature sensors are used to generate values that are subtracted from the readings of the other sensors in an electronic nose to correct for the temperature-dependent contributions of humidity to those readings. Hence, in principle, what remains after corrections are the contributions of the analytes only. Laboratory experiments on a first-generation electronic nose have shown that this method is effective and improves the success rate of identification of analyte/water mixtures. Work on a second-generation device was in progress at the time of reporting the information for this article.

This work was done by Margie Homer, Margaret A. Ryan, Kenneth Manatt, Hanying Zhou, and Allison Manfreda of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

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Brush/Fin Thermal Interfaces

High thermal conductance sliding interfaces can be achieved.

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Brush/fin thermal interfaces are being developed to increase heat-transfer efficiency and thereby enhance the thermal management of orbital replaceable units (ORUs) of electronic and other equipment aboard the International Space Station. Brush/fin thermal interfaces could also be used to increase heat-transfer efficiency in terrestrial electronic and power systems.

In a typical application according to conventional practice, a replaceable heat-generating unit includes a mounting surface with black-anodized metal fins that mesh with the matching fins of a heat sink or radiator on which the unit is mounted. The fins do not contact each other, but transfer heat via radiation exchange. A brush/fin interface also includes intermeshing fins, the difference being that the gaps between the fins are filled with brushes made of carbon or other fibers. The fibers span the gap between intermeshed fins, allowing heat transfer by conduction through the fibers. The fibers are attached to the metal surfaces as velvetlike coats in the manner of the carbon-fiber brush heat exchangers described in the preceding article. The fiber brushes provide both mechanical compliance and thermal contact, thereby ensuring low contact thermal resistance.

A certain amount of force is required to intermesh the fins due to sliding friction of the brush's fiber tips against the fins. This force increases linearly with penetration distance, reaching ~1 psi (~6.9 kPa) for full 2-in. (5.1 cm) penetration for the conventional radiant fin interface. Removal forces can be greater due to fiber buckling upon reversing the sliding direction. This buckling force can be greatly reduced by biasing the fibers at an angle perpendicularly to the sliding direction. Means of containing potentially harmful carbon fiber debris, which is electrically conductive, have been developed.

Small prototype brush/fin thermal interfaces have been tested and found to exhibit temperature drops about one-sixth of that of conventional meshing-fin thermal interface, when fabricated as a retrofit. In this case, conduction through the long, thin metal fins themselves becomes a thermal bottleneck. Further improvement could be made by prescribing aluminum fins to be shorter and thicker than those of the conventional meshing-fin thermal interfaces; the choice of height and thickness would be optimized to obtain greater overall thermal conductance, lower weight, and lower cost.

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