Miniature Oxidizer Ionizer for a Fuel Cell

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A proposed miniature device for ionizing the oxygen (or other oxidizing gas) in a fuel cell would consist mostly of a membrane ionizer using the same principles as those of the device described in the earlier article, "Miniature Bipolar Electrostatic Ion Thruster" (NPO-21057). The oxidizing gas would be completely ionized upon passage through the holes in the membrane ionizer. The resulting positively charged atoms or molecules of oxidizing gas could then, under the influence of the fringe fields of the ionizer, move toward the fuel-cell cathode that would be part of a membrane/electrode assembly comprising the cathode, a solid-electrolyte membrane, and an anode. The electro-oxidized state of the oxidizer atoms and molecules would enhance transfer of them through the cathode, thereby reducing the partial pressure of the oxidizer gas between the ionizer and the fuel-cell cathode, thereby, in turn, causing further inflow of oxidizer gas through the holes in the membrane ionizer. Optionally the ionizer could be maintained at a positive electric potential with respect to the cathode, in which case the resulting electric field would accelerate the ions toward the cathode.

This work was done by Frank Hartley of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).* *NPO-21087*

Miniature Ion-Array Spectrometer

The mode of operation would differ from that described in the preceding article.

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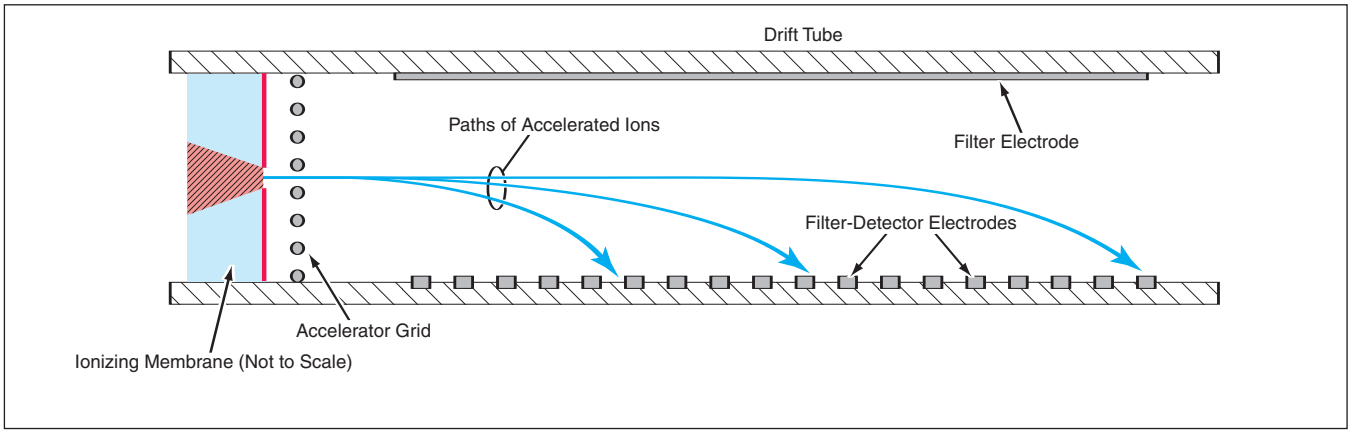
The figure depicts a proposed miniature ion-mobility spectrometer that would share many features of design and operation of the instrument described in the immediately preceding article. The main differences between that instrument and this one would lie in the configuration and mode of operation of the filter and detector electrodes. A filter electrode and detector electrodes would be located along the sides of a drift tube downstream from the accelerator electrode. These electrodes would apply a combination of (1) a transverse AC electric field that would effect differential transverse dispersal of ions and (2) a transverse DC electric field that would drive the dispersed ions toward the detector electrodes at different distances along the drift tube. The electric current collected by each detector electrode would be a measure of the current, and thus of the abundance of the species of ions impinging on that electrode. The currents collected by all the detector electrodes could be measured simultaneously to obtain continuous readings of abundances of species. The downstream momentum of accelerated ions would be maintained through neutralization on the electrodes; the momentum of the resulting neutral atoms would serve to expel gases from spectrometer, without need for a pump.

The proposed ion-mobility spectrometer would have no moving parts and would be extremely robust. It would consume little power, most of which would be attributable to the ion currents collected by the detector electrodes. The DC-DC converters needed to apply the required voltages and the amplifiers and controllers needed for operation and for processing of detector outputs could be constructed as application-specific integrated circuits. It has been estimated that the entire instrument could fit in a package smaller than a fingernail.

This work was done by Frank T. Hartley of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).* *NPO-21193*



This **Proposed Ion-Mobility Spectrometer** would give continuous readings of ion-species abundances. It would be smaller and simpler relative to prior ion-mobility spectrometers based on pulsed operation and a time-of-flight principle.