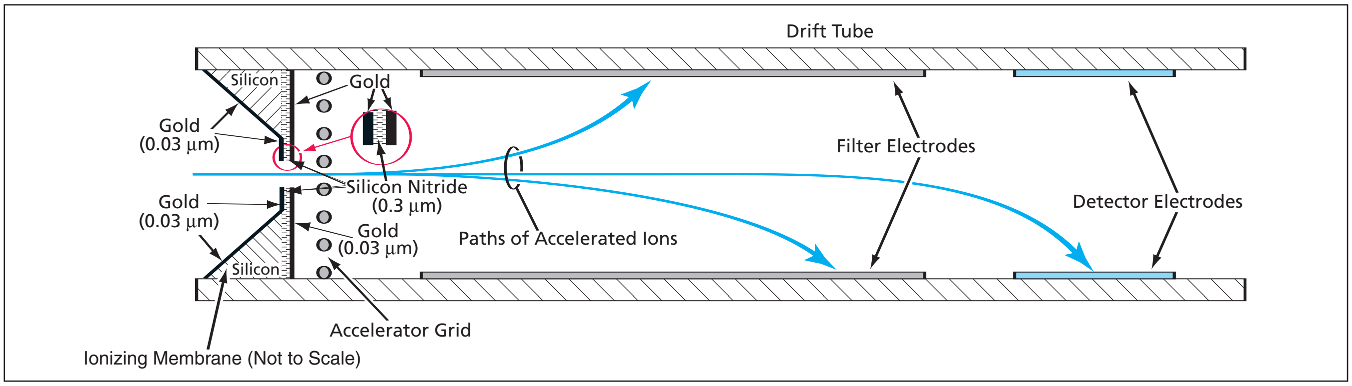

This **Proposed Ion-Mobility Spectrometer** would be made to sweep repeatedly through a spectrum of ionic species by applying a combination of AC and ramped DC voltages between the filter electrodes.

field. The AC field would effect differential transverse dispersal of ions. At a given instant of time, the trajectories of most of the ions would be bent toward the electrodes, causing most of the ions to collide with the electrodes and thereby become neutralized. The DC field would partly counteract the dispersive effect of the AC field, straightening the trajectories of a selected species of ions; the selection would vary with the magnitude of the applied DC field. The straightening of the trajectories of the selected ions would enable them to pass into the region between the detector electrodes. Depending on the polarity of the voltage applied to the detector electrodes, the electric field between the detector electrodes would draw the selected ions to one of these electrodes. Hence, the current collected by one of the detector electrodes would be a measure of the abundance of ions of the selected species. The ramping of the filter-electrode DC voltage would sweep the selection of ions through the spectrum of ionic species.

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-21109*

Mixed-Salt/Ester Electrolytes for Low-Temperature Li^+ Cells

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Electrolytes comprising, variously, $LiPF_6$ or $LiPF_6$ plus $LiBF_4$ dissolved at various concentrations in mixtures of alkyl carbonates and alkyl esters have been found to afford improved low-temperature performance in rechargeable lithium-ion electrochemical cells. These and other electrolytes have been investigated in a continuing effort to extend the lower limit of operating temperatures of such cells. This research at earlier stages, and the underlying physical and chemical principles, were reported in numerous previous *NASA Tech Briefs* articles, the most recent being "Ester-Based Electrolytes for Low-Temperature Li-Ion Cells" (NPO-41097), *NASA Tech Briefs*, Vol. 29, No. 12 (December 2005), page 59. The ingredients of the solvent mixtures include ethylene carbonate (EC), ethyl methyl carbonate (EMC), methyl butyrate (MB), and methyl propionate (MP). The electrolytes were placed in Li-ion cells containing carbon anodes and $LiNi_{0.8}Co_{0.2}O_2$ cathodes, and the electrical performances of the cells were measured over a range of temperatures down to –60 °C. The electrolytes that yielded the best low-temperature performances were found to consist, variously, of 1.0 M $LiPF_6$ + 0.4 M $LiBF_4$ or 1.4 $LiPF_6$ in 1EC + 1EMC + 8MP or 1EC + 1EMC + 8MB, where the concentrations of the salts are given in molar units and the proportions of the solvents are by relative volume.

This work was done by Marshall Smart and Ratnakumar Bugga of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
NPO-42862

Miniature Free-Space Electrostatic Ion Thrusters

NASA's Jet Propulsion Laboratory, Pasadena, California

A miniature electrostatic ion thruster is proposed for maneuvering small spacecraft. In a thruster based on this concept, one or more propellant gases would be introduced into an ionizer based on the same principles as those of the device described in the earlier article, "Miniature Bipolar Electrostatic Ion Thruster" (NPO-21057). On the front side, positive ions leaving an ionizer element would be accelerated to high momentum by an electric field between the ionizer and an accelerator grid around the periphery of the concave laminate structure. On the front side, electrons leaving an ionizer element would be ejected into free space by a smaller accelerating field. The equality of the ion and electron currents would eliminate the need for an additional electron- or ion-emitting device to keep the spacecraft charge-neutral. In a thruster design consisting of multiple membrane ionizers in a thin laminate structure with a peripheral accelerator grid, the direction of thrust could then be controlled (without need for moving parts in the thruster) by regulating the supply of gas to specific ionizer.

This work was done by Frank T. Hartley and James B. Stephens of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
NPO-21059