



Ester-Based Electrolytes for Low-Temperature Li-Ion Cells

NASA's Jet Propulsion Laboratory, Pasadena, California

Electrolytes comprising LiPF_6 dissolved at a concentration of 1.0 M in five different solvent mixtures of alkyl carbonates have been found to afford improved performance in rechargeable lithium-ion electrochemical cells at temperatures as low as -70°C . These and other electrolytes have been investigated in continuing research directed toward extending the lower limit of practical operating temperatures of Li-ion cells. This research at earlier stages, and the underlying physical and chemical principles, were reported in numerous previous NASA Tech Briefs articles, the most re-

cent being "Low-EC-Content Electrolytes for Low-Temperature Li-Ion Cells" (NPO-30226), NASA Tech Briefs, Vol. 27, No. 1 (January 2003), page 46. The ingredients of the present solvent mixtures are ethylene carbonate (EC), ethyl methyl carbonate (EMC), methyl butyrate (MB), methyl propionate (MP), ethyl propionate (EP), ethyl butyrate (EB), and ethyl valerate (EV). In terms of volume proportions of these ingredients, the present solvent mixtures are

- 1EC + 1EMC + 8MB,
- 1EC + 1EMC + 8EB,
- 1EC + 1EMC + 8MP,

- 1EC + 1EMC + 8EV, and
- 1EC + 9EMC.

These electrolytes were placed in Li-ion cells containing carbon anodes and $\text{LiNi}_{0.8}\text{Co}_{0.2}\text{O}_2$ cathodes, and the low-temperature electrical performances of the cells were measured. The cells containing the MB and MP mixtures performed best.

*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).
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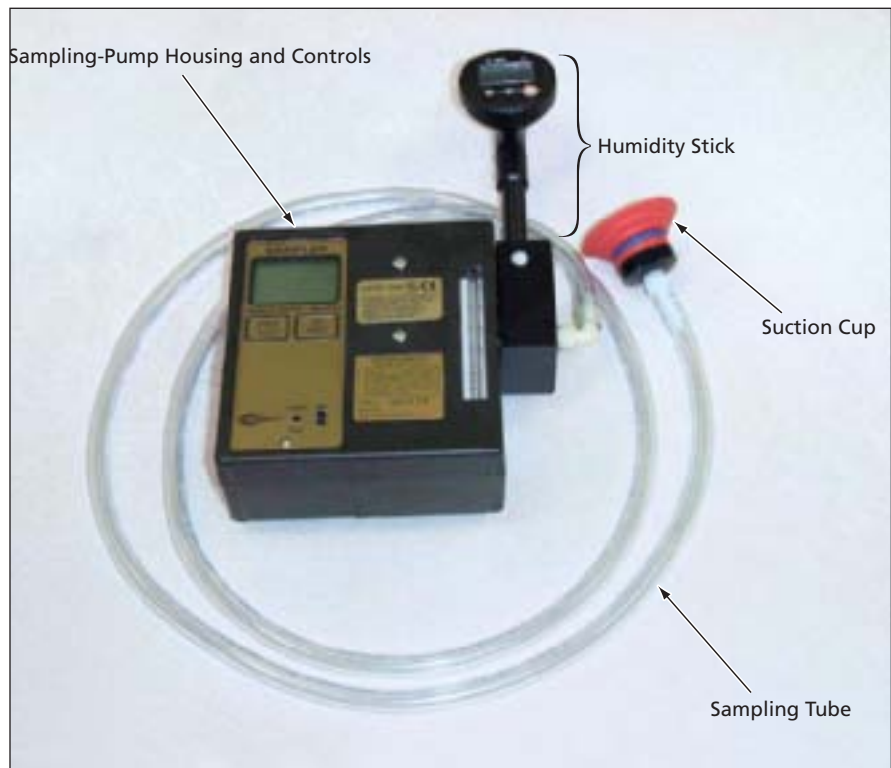
Hygrometer for Detecting Water in Partially Enclosed Volumes

This portable instrument samples humid air from difficult-to-reach spaces.

John F. Kennedy Space Center, Florida

A portable hygrometer has been devised to implement a pre-existing technique for detecting water trapped in partially enclosed volumes that may be difficult to reach and cannot be examined directly. The technique is based on the fact that eventually the air in such a volume becomes saturated or nearly so. The technique is straightforward: One measures the relative humidity and temperature of both the ambient air and a sample of air from the enclosed volume. If the relative humidity of the sample is significantly greater than that of the ambient air and/or if the sample is at or close to the dew point, then it can be concluded that water is trapped in the volume. Of course, the success of this technique depends on the existence of an access hole through which one can withdraw some air from the enclosed volume.

The portable hygrometer (see figure) includes (1) a commercially available small electronic temperature-and-humidity sensor of the "humidity stick" type, (2) a flexible plastic sampling tube with a suction cup at its inlet, and (3) a commercially available sampling pump,



This Portable Hygrometer was assembled from commercially available components and materials.