

Multiplexed Colorimetric Solid-Phase Extraction

This analytical platform enables simultaneous determination of trace analytes in water.

Lyndon B. Johnson Space Center, Houston, Texas

Multiplexed colorimetric solid-phase extraction (MC-SPE) is an extension of colorimetric solid-phase extraction (C-SPE) — an analytical platform that combines colorimetric reagents, solid phase extraction, and diffuse reflectance spectroscopy to quantify trace analytes in water. In C-SPE, analytes are extracted and complexed on the surface of an extraction membrane impregnated with a colorimetric reagent. The analytes are then quantified directly on the membrane surface using a handheld diffuse reflectance spectrophotometer. Importantly, the use of solid-phase extraction membranes as the matrix for impregnation of the colorimetric reagents creates a concentration factor that enables the detection of low concentrations of analytes in small sample volumes.

In extending C-SPE to a multiplexed format, a filter holder that incorporates discrete analysis channels and a jig that facilitates the concurrent operation of multiple sample syringes have been designed, enabling the simultaneous determination of multiple analytes. Separate, single analyte membranes, placed in a readout cartridge create unique, analyte-specific addresses at the exit of each channel. Following sample exposure, the diffuse reflectance spectrum of each address is collected serially and the Kubelka-Munk function is used to quantify each water quality parameter via calibration curves. In a demonstration, MC-SPE was used to measure the pH of a sample and quantitate Ag(I) and Ni(II).

This work was done by Daniel B. Gazda, James S. Fritz, and Marc D. Porter of Iowa State University for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to MSC-23850-1, volume and number of this NASA Tech Briefs issue, and the page number.

Detecting Airborne Mercury by Use of Polymer/Carbon Films

These films can be operated and regenerated at mild temperatures.

NASA's Jet Propulsion Laboratory, Pasadena, California

Films made of certain polymer/carbon composites have been found to be potentially useful as sensing films for detecting airborne elemental mercury at concentrations on the order of tens of parts per billion or more. That is to say, when the polymer/carbon composite films are exposed to air containing mercury vapor, their electrical resistances decrease by measurable amounts. Because airborne mercury is a health hazard, it is desirable to detect it with great sensitivity, especially in enclosed environments in which there is a risk of a mercury leak from lamps or other equipment.

The present effort to develop polymer-based mercury-vapor sensors complements the work reported in *NASA Tech Briefs* "Detecting Airborne Mercury by Use of Palladium Chloride" (NPO-44955), Vol. 33, No. 7 (July 2009), page 48 and "Detecting Airborne Mercury by Use of Gold Nanowires" (NPO-44787), Vol. 33, No. 7 (July 2009), page 49. Like those previously reported efforts, the present effort is motivated partly by a need to enable operation and/or regeneration of sensors under relatively mild conditions — more specifically, at temperatures

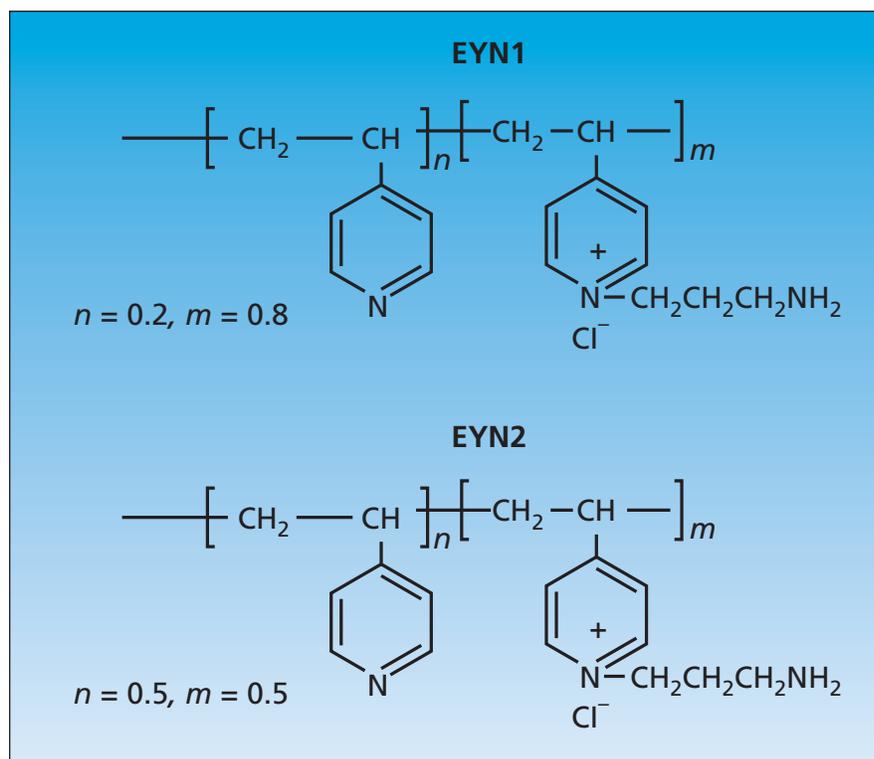


Figure 1. These Polymers were selected as components of mercury-detecting polymer/carbon sensor films based on quantum-mechanical computations of energies of binding between mercury atoms and polymer chemical functionalities, like these, containing amine functional group.