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NASA TECH BRIEF

Ames Research Center

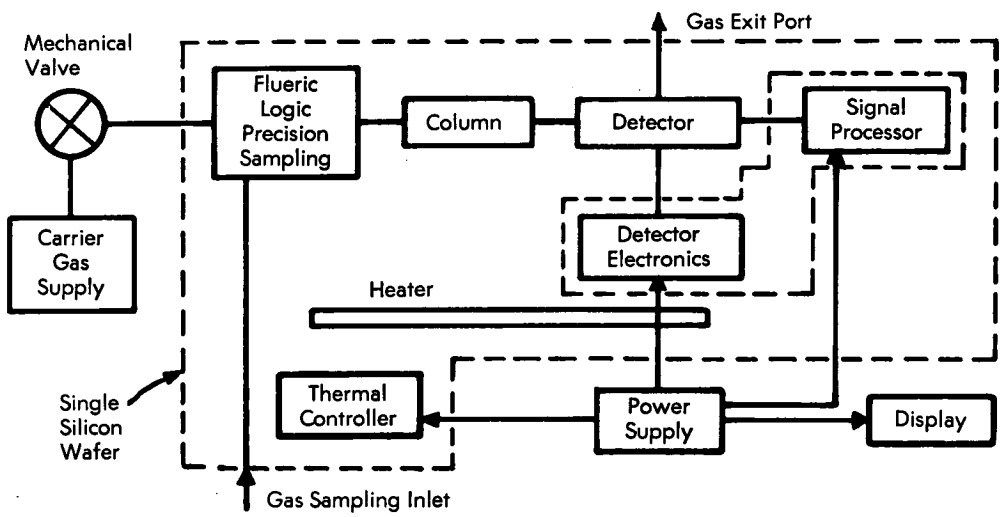
Microminiature Gas Chromatograph

The problem:

To provide a microminiature gas chromatograph at low cost.

The solution:

Construct a complete gas chromatograph on a silicon chip with the aid of the techniques and materials commonly used for fabrication of integrated circuits.



How it's done:

All components of the gas chromatograph, including sampling system, capillary column, detector, heaters, and controls are fabricated on the surfaces of a single, 2-cm square silicon wafer by the use of conventional photolithography and the etching techniques associated with the fabrication of integrated circuits. Gas flow channels are etched onto the silicon wafer and are contained by a thin glass plate bonded to the silicon surface. The shape of the channels and their depths are controlled by the etch-resistant mask as well as by crystal lattice orientation and the type of etching solution. The capillary column is a spiral channel about 70 μm deep and about 6.5 meters long; the inner areas may be coated with conventional liquid phases to carry out the desired chromatographic separations.

Several types of sampling systems can be incorporated; for example, the valve body of a diaphragm valve can be etched into the silicon chip and valve action can be accomplished with a silicon diaphragm (2 mm in diameter and 5 to 10 μm thick) bonded to the glass cover plate. This type of valve is easily controlled by differential pressure across the diaphragm, and can be incorporated with others in a manifold

(continued overleaf)

system to provide different types of sample inlets. Another type of inlet system can be made by etching a monostable multivibrator into the silicon in conjunction with two diaphragm valves to act as flueric diodes.

Detectors, such as thermistors or pyroelectric devices, can be incorporated directly into the column by beam-leading the desired element in place. A resistive film may be deposited on the wafer in various configurations so as to supply heat at required locations. Appropriate electronic circuitry for the gas chromatograph can be of integrated-circuit construction on the same silicon wafer or, preferably, on an adjacent wafer.

The microminiature gas chromatograph is completed by the addition of a gas supply and electrical power supplies.

Note:

No additional documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
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Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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