ated by an on-chip servocontrol subsystem that would strive to adjust the depth of penetration to maximize the strength of signals picked up by the electrodes. The ASIC will include a section for induction and/or radio reception of power and control signals from, and for transmission of electrode readout signals to, external equipment. A simple wire dipole antenna or a printed spiral coil on a flexible substrate could be used to couple the signals between the implant and external equipment, without need for wire connections.

This work was done by Jay Whitacre, Linda Y. Del Castillo, Mohammad Mojarradi, Travis Johnson, William West, and Richard Andersen of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

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 NPO-30516, volume and number of this NASA Tech Briefs *issue, and the page number.*

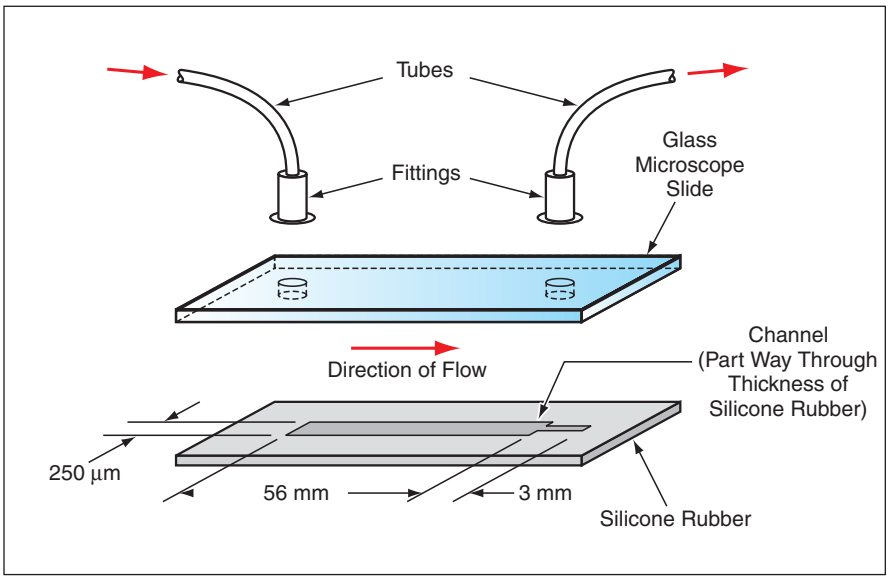
Microfluidic Devices for Studying Biomolecular Interactions

These devices can be fabricated rapidly and inexpensively.

Marshall Space Flight Center, Alabama

Microfluidic devices for monitoring biomolecular interactions have been invented. These devices are basically highly miniaturized liquid-chromatography columns. They are intended to be prototypes of miniature analytical devices of the "laboratory on a chip" type that could be fabricated rapidly and inexpensively and that, because of their small sizes, would yield analytical results from very small amounts of expensive analytes (typically, proteins). Other advantages to be gained by this scaling down of liquid-chromatography columns may include increases in resolution and speed, decreases in the consumption of reagents, and the possibility of performing multiple simultaneous and highly integrated analyses by use of multiple devices of this type, each possibly containing multiple parallel analytical microchannels.

The principle of operation is the same as that of a macroscopic liquid-chromatography column: The column is a channel packed with particles, upon which are immobilized molecules of the protein of interest (or one of the proteins of interest if there are more than one). Starting at a known time, a solution or suspension containing molecules of the protein or other substance of interest is pumped into the channel at its inlet. The liquid emerging from the outlet of the channel is monitored to detect the molecules of the dissolved or suspended substance(s). The time that it takes these molecules to flow from the inlet to the outlet is a measure of the degree of interaction between the immobilized and the dissolved or suspended molecules. Depending on the precise natures of the molecules, this measure can be used for diverse purposes: examples include screening for solution conditions that favor crystallization of proteins, screening for interactions between drugs and proteins, and determining the functions of biomolecules.



A **Basic Microfluidic Device** according to the invention includes a sheet of silicone rubber containing a molded channel that is exposed at its upper surface. The sheet is sealed to a glass microscope slide, thereby enclosing the channel.

The figure presents a schematic exploded view of a basic microfluidic device according to the invention. The device includes a sheet of polydimethylsiloxane (silicone rubber) that contains the channel and that is sealed to a glass microscope slide. In order to make this sheet, one first makes a mold that comprises a flat surface from which protrudes a ridge having the dimensions of the channel. The mold can be fabricated photolithographically on an oxidized silicon substrate. The silicone-rubber sheet is formed by casting the mixture of silicone-rubber ingredients on the mold.

Prior to assembly, a diamond-tipped drill is used to make holes in the microscope slide at the locations assigned to the inlet and outlet ends of the channel. After cleaning and oxidizing in an air plasma cleaner, the silicone-rubber sheet and the microscope slide are pressed together, taking care to align the holes with the ends of the channels. No adhesive is needed; an irreversible seal is formed spontaneously between the glass and the silicone rubber.

Fittings for tubes to carry the liquid are attached to the edges of the holes in the microscope slide. Particles coated with the substance to be immobilized in the column are suspended in a slurry,

which is then flushed along the channel. The channel is narrowed at its outlet end by an amount determined by the size of the particles, such that particles that arrive at the outlet become stuck there, preventing themselves and any others from flowing out of the channel (this phenomenon is known in the art as the keystone effect). As a result, the continued flushing with the slurry causes the channel to become packed with the particles.

This work was done by Wilbur W. Wilson and Carlos D. Garcia of Mississippi State University and Charles S. Henry of Colorado State University for **Marshall Space Flight Center**.

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 MFS-31978-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

Studying Functions of All Yeast Genes Simultaneously

This method could accelerate research on treatment of some diseases.

Ames Research Center, Moffett Field, California

A method of studying the functions of all the genes of a given species of microorganism simultaneously has been developed in experiments on *Saccharomyces cerevisiae* (commonly known as baker's or brewer's yeast). It is already known that many yeast genes perform functions similar to those of corresponding human genes; therefore, by facilitating understanding of yeast genes, the method may ultimately also contribute to the knowledge needed to treat some diseases in humans.

Because of the complexity of the method and the highly specialized nature of the underlying knowledge, it is possible to give only a brief and sketchy summary here. The method involves the use of unique synthetic deoxyribonucleic acid (DNA) sequences that are denoted as DNA bar codes because of their utility as molecular labels. The method also involves the disruption of gene functions through deletion of genes. *Saccharomyces cerevisiae* is a particularly powerful experimental system in that multiple deletion strains easily can be pooled for parallel growth assays. Individual deletion strains recently have been created for 5,918 open reading frames, representing nearly all of the estimated 6,000 genetic loci of *Saccharomyces cerevisiae*.

Tagging of each deletion strain with one or two unique 20-nucleotide sequences enables identification of genes affected by specific growth conditions, without prior knowledge of gene functions. Hybridization of bar-code DNA to oligonucleotide arrays can be used to measure the growth rate of each strain over several cell-division generations. The growth rate thus measured serves as an index of the fitness of the strain.

This work was done by Viktor Stolc of **Ames Research Center***; Robert G. Eason, Nader Pourmand, Zelek S. Herman, and Ronald W. Davis of Stanford Genome Technology Center; Waraporn Tongprasit of ELORET Corp.; and Kevin Anthony and Olufisayo Jejelowo of Texas Southern University. Further information is contained in a TSP (see page 1).*.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Innovative Partnerships Office, Ames Research Center, (650) 604-2954. Refer to ARC-15345-1.