"Lab on Chip" Device System with a Magnetic Clamp for Sealing Microfluidic Chips Against Wet Surfaces

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Technology description

UC San Diego inventors have developed an innovative “lab on chip” device and system to instantaneously and reversibly seal microfluidic chips (e.g. PDMS chip) against wet substrates (e.g. cover glasses) coated with cell cultures. It contains three parts, a magnetic clamp, a specially designed microfluidic chip, and a coating method to produce well-defined boundaries on substrates with controlled site densities of different molecules.

The magnetic clamp exerts a reproducible and uniform pressure on the microfluidic chip, achieving fast and reliable sealing with minimal mechanical perturbation to cells on the substrate.

Figure 1. Magnetic clamp setup: (a) photograph of assembled setup, view from the top; (b) photograph of the cover (viewed from the bottom) separated from the base; (c) close-up view of the central part of the cover with silicone cushion and PDMS chip; (d) schematic drawing of cross- section of assembled clamp setup.

Microfluidic devices with microchannel chips made of flexible materials, such as PDMS, are now widely used in biomedical research and find some applications in clinical assays. A standard device is comprised of a molded chip with microchannels engraved on its surface and a microscope cover glass that is bonded to the engraved surface of the chip to seal the microchannels.

However, the loading of cells into a microfluidic device can be a delicate task, especially if the cell stock is small as cells are sensitive to hydrodynamic stresses, or if a particular cell density on the cover glass needs to be reached.

The two main techniques that have been proposed to seal PDMS microchannel chips against wet cell culture-coated cover glasses are mechanical clamping and vacuum suction. However, mechanical clamps can substantially deform the microchannels of the PDMS chip, while the application of vacuum might cause changes in the gas content of the wet channel medium over time. Hence, both methods induce significant changes to the experimental setup that are difficult to detect and quantify.

Related Materials

Tkachenko E, Gutierrez E, Ginsberg MH, Groisman A, Smith, L. R., An Easy to Assemble Microfluidic Perfusion Device with a Magnetic Clamp. Lab Chip, 2009, 9(8):1085-95.

Gutierrez E, Petrich BG, Shattil SJ, Ginsberg MH, Groisman A, Kasirer-Friede A. Microfluidic Devices for Studies of Shear-Dependent Platelet Adhesion, Lab Chip, 2008, 8(9):1486-95.

Application area

The device can be used with a variety of microfluidic chips with adherent and/or non-adherent cells on the substrates to provide an advanced and versatile “lab on a chip” platform for research and clinical experiments, including shear stress response, chemotaxis, motility, and real-time microscopy.

Advantages

Reliably and instantaneously seals the microfluidic devices.
Causes negligible deformation to the microchannels.
The assembly and disassembly of setup is easy and takes a very short time.
Cells adhered to the cover glass stay intact and can be fixed, stained, and examined under a microscope.
No vacuum needed.
Superior to mechanical clamping.
Consistent and reproducible coating of the glass substrates.

Institution

University of California, San Diego

Inventors

Mark Ginsberg
Edgar Gutierrez
Eugene Tkachenko
Alexander Groisman

联系我们

叶先生

电 话：021-65679356

手 机：13414935137

邮 箱：yeyingsheng@zf-ym.com