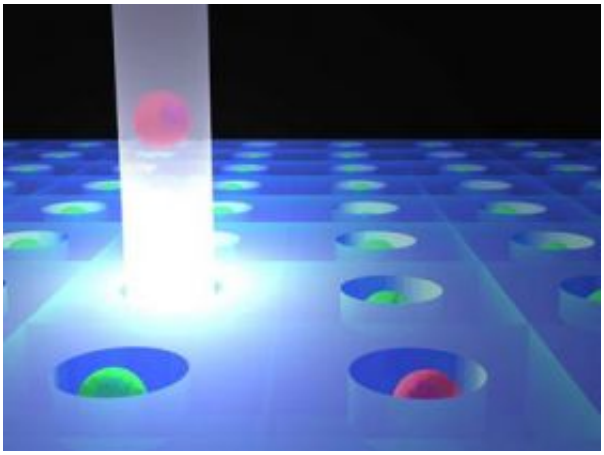
Scientists sort cells with beams of light

December 10 2007



MIT has developed a new system for sorting cells that involves special "traps" in a silicone layer bonded to a microscope slide. Cells with specific properties are then levitated out of their traps using the pressure of a beam of targeted light from a low-cost laser. A flowing fluid then sweeps the selected cells off to a separate reservoir Image courtesy / Joseph Kovac, MIT

Separating out particular kinds of cells from a sample could become faster, cheaper and easier thanks to a new system developed by MIT researchers that involves levitating the cells with light.

The system, which can sort up to 10,000 cells on a conventional glass microscope slide, could enable a variety of biological research projects that might not have been feasible before, its inventors say. It could also find applications in clinical testing and diagnosis, genetic screening and cloning research, all of which require the selection of cells with

particular characteristics for further testing.

Joel Voldman, an associate professor in MIT's Department of Electrical Engineering and Computer Science, and Joseph Kovac, a student in the department, developed the new system, which is featured as the cover story in the Dec. 15 issue of the journal *Analytical Chemistry*.

Present methods allow cells to be sorted based on whether or not they emit fluorescent light when mixed with a marker that responds to a particular protein or other compound. The new system allows more precise sorting, separating out cells based not just on the overall average fluorescent response of the whole cell but on responses that occur in specific parts of the cell, such as the nucleus. The system can also pick up responses that vary in how fast they begin or how long they last.

"We've been interested in looking at things inside the cell that either change over time, or are in specific places," Voldman says. Separating out cells with such characteristics "can't be done with traditional cell sorting."

For example, if cells differ in how quickly they respond to a particular compound used in the fluorescent labeling, the new system would make it possible to "select out the ones that are faster or slower, and see what's different," says Voldman, who also has appointments in MIT's Research Laboratory of Electronics and the Microsystems Technology Laboratories.

"It seems like that should be easy, but it isn't," he said. There are other ways of accomplishing the same kind of cell separation, but they require complex and expensive equipment, or are limited in the number of cells they can process.

The new system uses a simple transparent silicone layer bonded to a

conventional glass microscope slide. Fabricated in the layer are a series of tiny cavities, or traps, in which cells settle out after being added to the slide in a solution. Up to 10,000 cells could be sorted on a single slide.

Looking through the microscope, either a technician or a computerized system can check each cell to determine whether it has fluorescence in the right area or at the right time to meet the selection criteria. If so, its position is noted by the computer. At the end of the selection process, all of the cells whose positions were recorded are then levitated out of their traps using the pressure of a beam of targeted light from a low-cost laser. A flowing fluid then sweeps the selected cells off to a separate reservoir.

The laser levitation of the cells acts like “a fire hose pushing up a beach ball,” Voldman says. But the laser method is gentle enough that the living cells remain viable after the process is complete, allowing further biological testing.

Voldman and Kovac are continuing to refine the system, working on making it easier to use and on improving its ability to keep samples sterile. Voldman says that unlike expensive separation techniques such as optical tweezers, the new system could cost only a few thousand dollars. As a result, it could be employed in a variety of biological research laboratories or clinical settings, not just in big, centralized testing facilities.

Source: Massachusetts Institute of Technology