Water droplets as miniaturized test tubes

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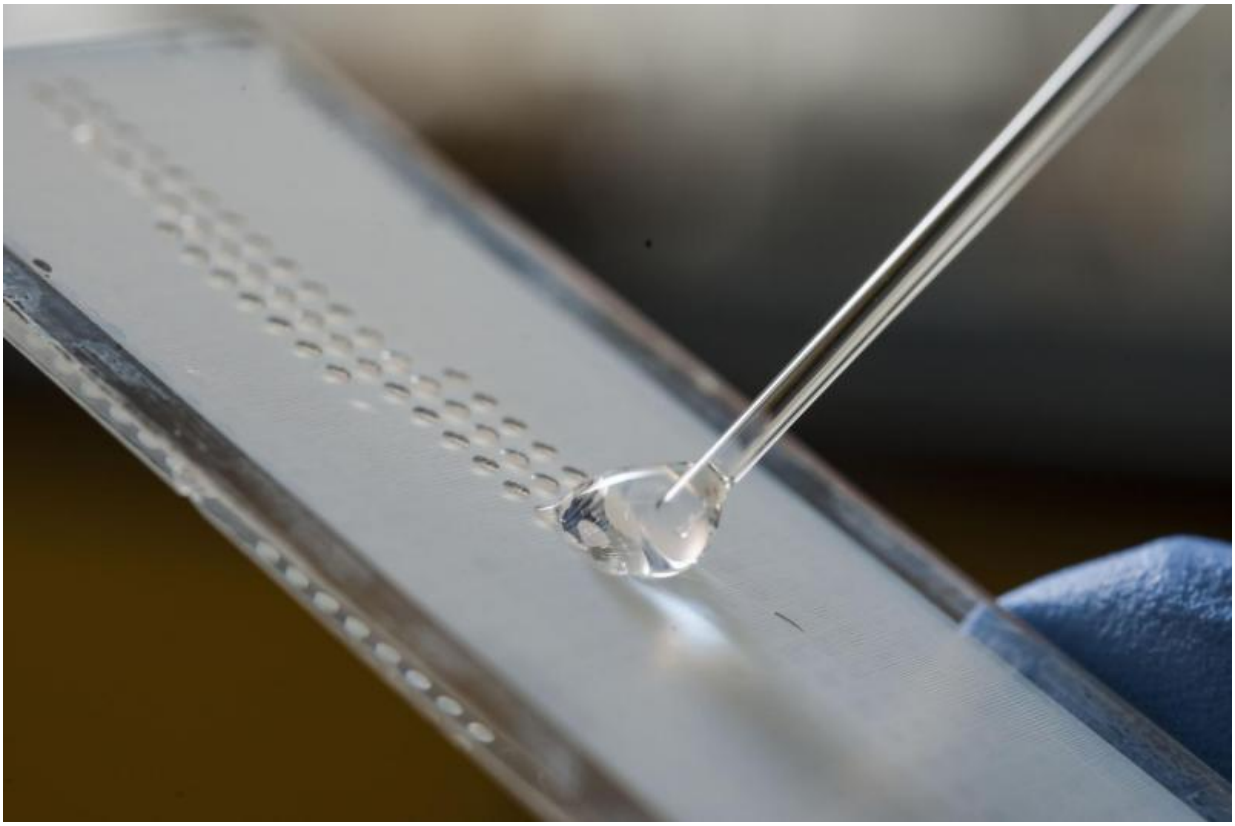

Fluids self-arrange in smallest droplets on a DMA. Credit: KIT

Scientists of Karlsruhe Institute of Technology (KIT) have developed laboratory equipment that facilitates the search for active substances and the examination of cell samples, reducing costs by a factor of up to 100.

Treatment methods can now be adapted better to the individual needs of

patients. Scientists at KIT have found a way to execute so-called high-throughput screenings with thousands of samples tested in parallel without any expensive, complex robotic systems that have been necessary so far.

Chemist Pavel Levkin of KIT's Institute of Toxicology and Genetics (ITG) and his multidisciplinary team have developed a surface on which aqueous solutions self-arrange in thousands of separate droplets. "On a droplet microarray (DMA), biological samples such as tissue from a biopsy can be subjected to substance screening," says team member Simon Widmaier.

Every individual droplet is used as a test tube for biological experiments. Pipetting robots and pipette tips used today are no longer required. "An individual laboratory employee can execute thousands of substance screening experiments within a few seconds." The cost reduction potential of this new technology is enormous, according to Widmaier. "A pipetting robot costs several 10,000 euros and has to be operated by an expert." Each pipetting step alone costs five to seven cents for a pipette tip.

By means of a highly precise UV exposure method, highly hydrophilic and highly water-repellent areas are produced on the array surface. As a result, the size of the droplets to be investigated can vary between three and 250 nanoliters (one nanoliter corresponds to one billionth of a liter). When using conventional microtiter plates with lines and rows of depressions, at least 40 microliters (one millionth of a liter) of reactants are required. "Estimated roughly, a DMA consumes a thousand times less reactant. As these substances often are very expensive—some are more expensive than gold—this is a big advantage for users," Widmaier says.

Moreover, classical pipetting technology does not allow for portioning

fluids with finely dispersed solids, e.g. cells, in nanoliter amounts. On the novel biologically compatible polymer, by contrast, experiments are possible using a few living cells. The technology has big advantages when screening stem and primary cells for the effect of substances on human organs. Widmaier expects that screening results will be more reliable and development of medicine will be much cheaper in the future.

The researchers also want to make it easier for diagnostic laboratories to perform personalized substance screenings for e.g. cancer treatment. Last, but not least, costs of large pharmaceutical companies will be reduced. "The DMA technology solves the central problem of miniaturization of cell experiments and allows for screenings of medical substances and smallest cell volumes, an example being biopsy tissues of patients. We want to develop, produce, and commercialize droplet microarrays, product platforms, and screening kits, and offer them to research institutes, screening centers, and pharmaceutical companies for cell-based substance screening in the context of personalized medicine," Widmayer says. First prototypes are being tested on the market.

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