Diagnosis by Patterned Paper

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Testing biological fluids such as blood and urine is essential for both diagnostics and routine checks. In remote, non-industrialized regions or for emergency on-the-spot diagnosis, current methods of laboratory analysis are far too complicated.

George M. Whitesides and his team at Harvard University in Cambridge, Massachusetts (USA) have now developed a prototype for a new class of inexpensive, highly practical rapid tests that can be used to carry out several biological tests simultaneously on a single drop. As they describe in the journal *Angewandte Chemie*, their tests are based on tiny pieces of paper onto which defined, millimeter-sized channels are printed.

To produce these, highly absorbent paper is treated with a photosensitive coating and covered with a mask that is the negative of the desired pattern. When the paper is irradiated with UV light through the mask, the molecules of the photosensitive coating change so that subsequent heating converts them to a continuous polymer layer. The untreated coating under the mask can be washed away, while the polymer layer on the irradiated spots is bound fast to the paper. This system allows the researchers to produce a tiny system of channels separated from each other by “channel walls” made of the water-repellent polymer.

As a prototype, Whitesides and his team selected a clover-leaf-shaped channel system: A main channel branches into three tiny chambers. Different color reagents are introduced into each of these chambers and are allowed to dry. The first chamber contains a reagent for a glucose test and the second a protein test; the third is a control. When a drop of

liquid is introduced, the capillary action of the paper quickly sucks it up and transports it into all three chambers.

A series of tests with artificial urine demonstrated that the intensity of the (simultaneously occurring) color reactions corresponds to the glucose and protein concentrations. The sensitivity of detection is comparable to conventional glucose and protein test strips.

Crucial to implementation in the field, the tests are not affected by contamination by dust, dirt, or plant materials, because these particles are not absorbed by the paper.

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