Goodbye to Pinpricks

A new noninvasive breath test will replace the painful prick of diabetes testing

For millions of patients with diabetes, pain inevitably accompanies blood-sugar monitoring. Pricking a finger to extract a drop of blood onto a testing strip for a glucose reading—repeated maybe four to seven times a day—is necessary to control glucose levels and to prevent serious complications such as kidney failure, blindness, nerve damage, and poor blood circulation.

Los Alamos scientist Yixiang Duan and his colleagues are developing a new noninvasive breath test to replace the painful prick.

In diabetics, low insulin levels allow sugar to accumulate in the blood instead of being metabolized and made available to cells. The body compensates by digesting fatty acids and producing chemical byproducts called ketones. Acetone, one of those ketones, builds up in the blood and gets transferred preferentially to the breath, where a high concentration is a sure sign of increased blood sugar. In healthy people that concentration is about several hundred parts per billion, but it can be 10 to several hundred times greater in diabetics, depending on the level of insulin in the body.

Duan and his colleagues have designed and developed a very-sensitive compact device for testing the breath acetone level. First, a small precision device ionizes a stream of inert gas (helium or argon) to form a stable micro-size volume of plasma the size of the tip of a ballpoint pen.

A sample of breath is allowed to mix with the microplasma, breaking the acetone molecules and creating a special set of excited or ionized fragments that emit optical light. A palm-size spectrometer analyzes that light and displays the results on a screen. For a certain range of acetone concentrations, the amplitude of the light signal is proportional to, and therefore a quantitative measure of, the breath acetone level.

This method has been patented, and both the device that generates the microplasma and the palm-size spectrometer have been developed and implemented. Duan and his colleagues expect to integrate their apparatus into a compact hand-held device for on-site breath-gas monitoring and analysis in hospitals and private homes.