For diabetics, spectroscopy may replace painful pinpricks

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Part of managing diabetes involves piercing a finger several times daily to monitor blood sugar levels. Raman spectroscopy could let diabetics monitor glucose without those daily pinpricks. In the past, this would have required a tabletop's worth of equipment. Two former graduate students at MIT's George R. Harrison Spectroscopy Laboratory, Chae-Ryon Kong and Ishan Barman, detail in the AIP's journal *AIP Advances* how to potentially reduce the overall size of this sensor by making an important part of this equipment smaller.

Their Raman spectrograph works by shining a low-powered laser though the thin fold of skin between the thumb and forefinger. As the laser's photons move through the skin, they strike the vibrating molecules around them. A portion of these photons interact with the vibrating molecules in ways that change their energy levels. This is called Raman scattering.

Each type of molecule produces a unique set of energy levels that show up as a spectrum and identify the molecule. Unfortunately, less than one out of one million photons undergoes Raman scattering. So it is important to capture as many scattered photons as possible, then filter out everything but the Raman photons. Optical filters can do this, but they are only effective when the photons hit them within a narrow range of angles. Previous researchers have used a compound parabolic concentrator (CPC) for this purpose, yet it takes a very large CPC to achieve the high degree of collimation needed.

Kong and Barman turned to a more compact mirror, a compound hyperbolic concentrator (CHC), which uses a lens to focus light into the necessary tight beam. "The new design is from five to 20 times smaller than if we used a CPC to achieve the same performance," Kong said. This development is the first step toward making portable Raman spectroscopy possible. According to Ramachandra Dasari, the lab's associate director, such portable Raman spectrographs could also be used to identify other blood chemical markers of disease, and to determine if biopsies contain cancerous tissue. The corresponding tests would take about one minute. The current prototype is the size of a shopping cart. "Our next step is to miniaturize this and make it portable," he said. Dasari expects to build a portable prototype over the next couple of years.

More information: "A novel non-imaging optics based Raman spectroscopy device for transdermal blood analyte measurement" by Chae-Ryon Kong et al., is published in *AIP Advances*.

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