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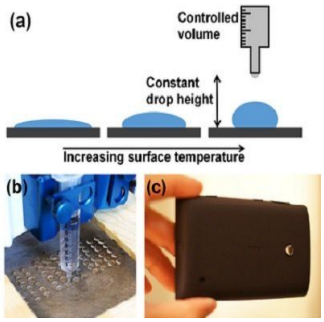
Special Lens Turns Smartphone into Microscope



University of Houston researchers have found an easy (and inexpensive) way to transform a smartphone into a microscope: an optical lens made of polydimethylsiloxane (PDMS). The lens, which attaches directly to a smartphone camera lens, can magnify images by a magnitude of 120 — all for just 3 cents a lens.

"Our lens can transform a smartphone camera into a microscope by simply attaching the lens without any supporting attachments or mechanism," the UH researchers write in a report published in the *Journal of Biomedical Optics*. "The strong, yet non-permanent adhesion between PDMS and glass allows the lens to be easily detached after use. An imaging resolution of 1 (micrometre) with an optical magnification of 120X has been achieved."

The UH team describes how the lens is created: PDMS, a polymer with the consistency of honey, is dropped precisely on a preheated surface to cure. Lens curvature — and therefore, magnification — depends on how long and at what temperature the PDMS is heated. The resulting lenses are flexible, similar to a soft contact lens, although they are thicker and slightly smaller.

Conventional lenses are produced by mechanical polishing or injection moulding of materials such as plastics or glass. Liquid lenses are available, too, but those that are not cured require special housing to remain stable. Other types of liquid lenses require an additional device to adhere to the smartphone. In contrast, the PDMS lens attaches directly to the phone's camera lens and remains attached, the researchers say, noting that the lens is reusable.

For the study, Wei-Chuan Shih, assistant professor of electrical and computer engineering at UH, and three graduate students captured images of a human skin-hair follicle histological slide with both the smartphone-PDMS system and an Olympus IX-70 microscope. At a magnification of 120, the smartphone lens was comparable to the Olympus microscope at a magnification of 100, and software-based digital magnification could enhance it further.

The cost and ease of using the PDMS lens as a microscope — by attaching it directly to a smartphone camera lens, without the use of any additional device — make it ideal for use with younger students in the classroom, according to Professor Shih. It also could have clinical applications, allowing small or isolated clinics to share images with specialists located elsewhere, he adds.

The study's first author, Yu-Lung Sung, a doctoral candidate, estimates that it will cost about 3 cents to manufacture the lenses in bulk. A conventional, research quality microscope, by comparison, can cost $10,000. "A microscope is much more versatile, but of course, much more expensive," Sung points out.

For now, the researchers are producing the lenses by hand, using a hand-built device that functions similarly to an inkjet printer. However, producing the lenses in bulk will require funding, and the UH team has launched a crowdfunding campaign through Indiegogo, hoping to raise $12,000 for the equipment.

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