Expanding the (Microscopic) View

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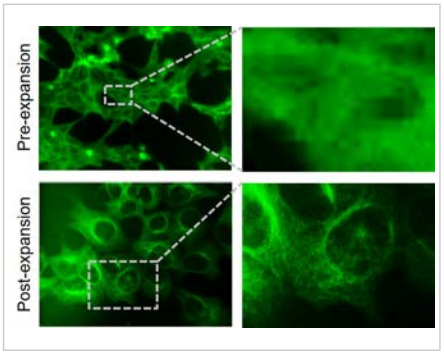
A hybrid microscopy technique makes inexpensive high-resolution imaging possible for clinical and research applications. Learn more...

Recently developed miniature microscopes have the potential to improve medical diagnostics in regions where access to traditional microscopes is limited, but their resolution is often too low to see bacteria and other similarly sized pathogens. Now, by combining two independently developed microscopy techniques, researchers have developed a cheap, lightweight microscope that matches the resolution of benchtop microscopes. "It was a perfect storm of technologies that developed independently and then were integrated," said study author, Ali Khademhosseini, a bioengineer at Harvard Medical School.



Khademhosseini's team developed one such mini-microscope with fluorescent capacity that costs $5 to $80, depending on resolution and sensitivity. To expand the utility of their microscope, Khaledhosseini teamed up with Ed Boyden, a neuroscientist at MIT, whose team recently developed a method called expansion microscopy. Expansion microscopy uses a gel matrix that swells to physically expand an embedded biological specimen for improved imaging. By melding expansion microscopy with the miniature fluorescent microscope, the two teams were able to overcome the resolution problem that plagues most mini-microscopes. "When [Boyden] started to finalize his concepts of expansion microscopy, that's when the light bulbs went off," said Khademhosseini. "It adds the right kind of resolution for global health applications." They dubbed the hybrid the Expansion Mini-Microscope, or ExMM.

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Being able to detect contamination in water sources or sepsis in blood are not major issues in developed countries, but these tasks can be nearly impossible to do in a timely way in areas where traditional laboratory facilities are hard to reach. The ExMM offers the possibility of point-of-care diagnostics in these places and should also facilitate biological field research and early science education, since its portability and low cost make it a better alternative to bulky benchtop microscopes.

For non-clinical uses, Khaledhosseini expects the ExMM to roll out fairly quickly, but medical diagnostic use requires regulatory approval, which could take several years. Currently, using the ExMM still requires antibodies and other reagents that limit its use. Boyden's team is developing a kit to make it easier to scale up use of the ExMM. In the future, the kit could also be used with a mobile phone, which could make the ExMM even more widely accessible.

Reference

Zhang, Y.S. et al. "Hybrid Microscopy: Enabling Inexpensive High-Performance Imaging through Combined Physical and Optical Magnifications" Scientific Reports, (2016) doi: 10.1038/srep22691

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