Pacific Northwest NATIONAL LABORATORY

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# PNNL Smartphone Microscope

## SUMMARY

The microscope slips over the camera lens of the cell phone and is no thicker than a phone case. It's designed to fit most cell phone brands, including iPhone 4 and 5, Galaxy S3 and S4 phones and iPads. The material cost, not including the printer, is under $1.


Using inexpensive glass beads traditionally used for reflective pavement markings at airports, the PNNL team has demonstrated 1000x magnification, which is necessary to see tiny anthrax spores and plague cells. They have also made a 350x version, which is adequate to identify parasites in a blood samples or protozoa in drinking water. A 100x version enables children to investigate common items like salt grains and flower petals in much greater detail.

Using glass spheres as a microscope lens is not a new idea, optically, but the small size of the housing combined with very high magnification and extremely low cost is what makes this device practical.

Low cost was a driver in the research and development project targeting a specific Department of Homeland Security need for rapid bio detection technologies. The microscope needed to be so cheap it could literally be thrown away – in case it gets contaminated.

"We feel there are many uses out there including human and veterinary medicine in developing countries," said Janine Hutchison a microbiologist at PNNL. "We are also really excited about engaging kids in science. School districts have a hard time providing enough microscopes for students. Our science education staff is getting it into the hands of local school children this fall through the auspices of the Mid-Columbia STEM Education Collaboratory."

Troubleshooting Tips

Start with the 100x version if possible. Learning and getting familiar with the system using the lowest magnification possible will increase the usefulness with the higher magnification versions. The higher magnification versions are more sensitive to alignment and take more time and practice to produce good images.

The lens must be pushed into the plastic housing until the front of the lens is flush with the housing. If the camera is having trouble focusing on an object, double

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check the lens placement to make sure the lens is fully seated in the plastic.

If the image has blurry or dark spots that never change no matter what you are imaging, it could be from a dirty lens or defects in the lens. Try to clean the lens using water or rubbing alcohol and a soft cloth or tissue. If this doesn't help, and if the image is degraded too much due to these defects, pop out the lens and replace it with a new one.

Beads used by PNNL

http://www.biospec.com/product/297/glass_beads/

Cat. No. 11079110

http://www.mo-sci.com/

GL-0179B/3000

Other sources for beads:

http://www.sigmaaldrich.com/catalog/product/aldrich/z265926?lang=en&region=US

http://www.avogadro-lab-supply.com/item/3_mm_Flint_Glass_Beads_Column_Packing_1_lb/803

## ADVANTAGES

See attached press release.

## RELATED LINKS

» **100X Multi-Platform**

*https://www.midcolumbiastem.org/SiteCollectionDocuments/Smartphone%20Microscope/100Clip.stl*

» **350X Multi-Platform**

*https://www.midcolumbiastem.org/SiteCollectionDocuments/Smartphone%20Microscope/350Clip.stl*

» **350X Multi-Platform w/ Slideholder**

*https://www.midcolumbiastem.org/SiteCollectionDocuments/Smartphone%20*

### Technology Portfolio(s)

» Biosensors

### Potential Industry Applications

» Consumer Products

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