Helium raises resolution of whole cell imaging

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The ability to obtain an accurate three-dimensional image of an intact cell is critical for unraveling the mysteries of cellular structure and function. However, for many years, tiny structures buried deep inside cells have been practically invisible to scientists due to a lack of microscopic techniques that achieve adequate resolution at the cell surface and through the entire depth of the cell. Now, a new study published by Cell Press in the October 4th issue of *Biophysical Journal* demonstrates that microscopy with helium ions may greatly enhance both surface and sub-cellular imaging.

Electron microscopy has been the most commonly used technique for high resolution imaging of sub-cellular structure. An electron microscope uses a beam of electrons to produce a magnified image of a sample. Electrons can achieve a greater resolution than the photons of visible light because they have much shorter wavelengths. However, the electron microscope has limitations. To scan the surface of a biological structure like a cell, the surface must first be coated with an ultrathin layer of electrically conductive metal. When it comes to high resolution of thick samples, the electrons scatter as they penetrate a sample, so, while this type of microscopy is amenable to thin sections, it is not suitable for imaging whole cells.

"In order to get high resolution cell images from any scanning beam microscope, one must be able to produce a sufficiently small probe which maintains its probe size as it penetrates the cell, and measure signals emanating from a localized region within the sample," explains

senior study author, Dr. Frank Watt, from the National University of Singapore.

"Microscopy using helium ions may play a major role in both surface and sub-cellular imaging. Slow helium ions can image insulating biological surfaces at sub nanometer resolutions without the need for a metallic conductive coating, and fast helium ions can image the interior of cells without a significant loss of resolution."

Dr. Watt and colleagues used helium ion microscopy to show that fast helium ions maintain a straight path as they pass through a cell and that by measuring the energy loss of each helium ion as it passed through the cell, they could create an image representative of the mass distribution of the cell.

"Helium ion microscopy has high potential for imaging both surface and internal structures in whole cells are resolutions not attainable using other techniques," concludes Dr. Watt. "This work paves the way for the utilization of ions for whole cell investigations at nanometer resolutions."

More information: Whole-Cell Imaging at Nanometer Resolutions Using Fast and Slow Focused Helium Ions, Biophysical Journal Volume 101 October 2011 1788–1793. doi: 10.1016/j.bpj.2011.08.028

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