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Helium Ion of Nanoparticles Microscopy of Cellular Interactions

BW Arey, V. Shutthanandan, G. Orr

W. R. Wiley Environmental Molecular Sciences Laboratory, Pacific Northwest National Laboratory, P.O. Box 999, K8-80, Richland, WA 99354

The helium ion microscope (HeIM) probes light elements (e.g. C, N, O, P) with high contrast due to the la rge variation in secondary electron yield, which minimizes the necessity of specimen staining. A defining characteristic of HIM is its remarkable capability to neutralize charge by the implementation of an electron flood gun, which eliminates the need for coating non-conductive specimens for imaging at high resolution. In addition, the small convergence angle in HeIM offers a large depth of field (~5x FE-SEM), enabling tall structures to be viewed in focus within a single image. Taking advantage of these capabilities, we investigate the interactions of engineered nanoparticles (NPs) at the surface of alveolar type II epithelial cells grown in culture. The increasing use of nanomaterials in a wide range of commercial applications has the potential to increase human exposure to these materials, but the impact of such exposure on human health is still unclear. One of the main routs of exposure is the respiratory tract, where alveolar epithelial cells present a vulnerable target. Since the cellular interactions of NPs govern the cellular response and ultimately determine the impact on human health, our studies will help delineating relationships between particle properties and cellular interactionsresponse to better evaluate NP toxicity or biocompatibility. The Rutherford backscattered ion (RBI) is a helium ions imaging mode, which backscatters helium ions from every element except hydrogen, with a backscatter yield that depends on the atomic number of the target. Energy-sensitive backscatter analysis is being developed, which when combined with RBI image information, support elemental identification at helium ion submicron resolution. This capability will enable distinguishing NPs from cell surface structures with nanometer resolution. This research was performed using EMSL, a national scientific user facility sponsored by the Department of Energy's Office of Biological and Environmental Research located at Pacific Northwest National Laboratory.

References:

1. Carl Zeiss SMT-NTS Division Peter Gnauk, He Ion Microscope: a new instrument concept for high-resolution materials analysis : A. Vladar, B. Ming, MT. Postek NIST, Nanometer-scale imaging and metrology,
2. A. Vladar, B. Ming, MT. Postek NIST, Nanometer-scale imaging and metrology, nano-fabrication with the Orion Helium Ion Microscope
3. Orr G, Panther DJ, Cassens J, Phillips JL, Tarasevich BJ, Pounds JG. (2009) Syndecan-1 mediates the coupling of positively charged submicrometer amorphous ilica particles with actin filaments across the alveolar epithelial cell membrane. oxicology and Applied Pharmacology. 236, 210-220.

4. Orr G, Panther DJ, Phillips JL, Tarasevich BJ, Hu D, Teeguarden JG, Pounds JG. (2007) Submicrometer and nanoscale inorganic particlesexploit the actin machinery to be propelled along microvilli-likestructures into alveolar cells. ACS Nano. 1(5)463-475.

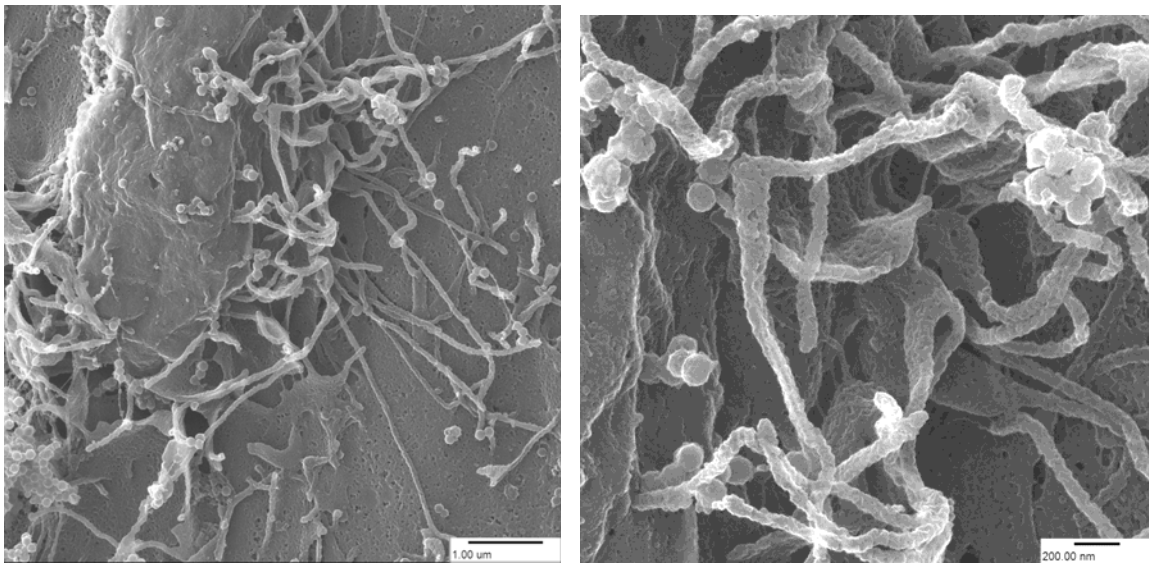

Fig. 1 Helium Ion Image of alveolar type II epithelial cells with Silica Nanoparticles.

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