Application Note

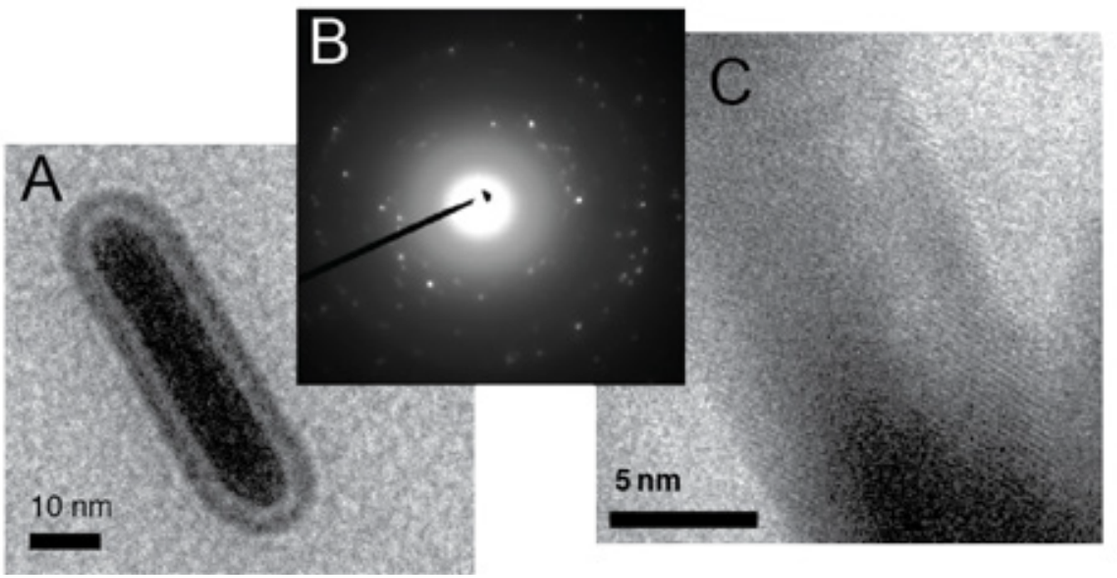
Poseidon™

Polyvinyl Pyridine Coated Gold Nanorods Imaged in Liquid

Experiment

Gold nanorods encapsulated in a layer of polyvinyl pyridine (PVP) were imaged in a 150 nm layer of water with Transmission Electron Microscopy (TEM) using Protochips' *in situ* liquid EM system, Poseidon.

(A) TEM image of a single PVP encapsulated gold nanorod. The gold nanorod core is ~50 nm long with a diameter of ~10 nm. The PVP surface coating was measured between 4 and 5 nm thick. Thus, the overall thickness of the PVP gold nanoparticles is ~20 nm, which is <14% of the liquid thickness set by the E-chip spacer. (B) Diffraction pattern of the PVP-gold nanorods imaged in solution with TEM. The sample was imaged in diffraction mode for several minutes, during which the diffraction pattern appeared to pulse, as the nanorods moved in and out of the focal plane due to Brownian motion. (C) HRTEM image showing the crystal lattice structure of the gold nanorod core.



The lattice spacing is ~2 Å, which corresponds to the 200 lattice plane spacing (0.204 nm), demonstrating the feasibility of obtaining atomic resolution when imaging under fully hydrated conditions.

Sample Prep and Imaging Conditions

Selection of the appropriate E-chip pair is the first step in obtaining high quality images using Poseidon. For nanomaterials, utilizing thin E-chip windows (20 µm lateral width) oriented crossways to one another provides the most consistently thin liquid layer . The spacer E-chip used in this experiment to set the liquid thickness and contain the sample is listed below.

- **Spacer E-chip: EBP-45FDC**
  - Thickness: 150 nm
  - Configuration: Static
  - Window: Thin (20 µm)
- **E-chip orientation: Crossed**

Prior to loading, both the spacer and cover E-chip were glow discharged for 2 minutes to render the surface hydrophilic. The spacer E-chip was placed in the holder

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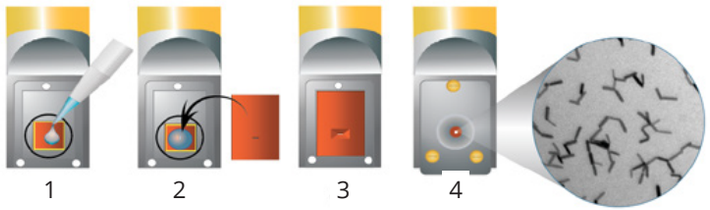
tip and a 0.5 µL droplet of PVP-gold nanorods diluted in water was deposited onto the E-chip. (Sample was diluted ten-fold from a stock solution of optical density 50). The large E-chip was inverted and loaded into the Poseidon holder so that it rested on top of the spacer E-chip. The lid was secured to the holder tip and the vacuum seal was tested prior to insertion into the microscope using a dry pumping stage. TEM and diffraction images were recorded using a JEOL 3200 FS operated in TEM mode.



(1) Sample suspended in solution was dispensed onto the spacer E-chip.
(2) The large E-chip was inverted and placed on top of the sample.
(3) The two E-chips self-aligned within the tip of the holder.
(4) The lid was secured to the tip to seal the sample from the vacuum and the sample was imaged in the electron microscope.

The Poseidon E-chip family of sample supports provides an unparalleled level of flexibility for your liquid *in situ* experiments. To accommodate the wide variety of samples used in the materials and life sciences markets, the E-chip family provides the user the ability to specify three key parameters to optimize the platform for the particular sample and experiment. Imparting this flexibility to the consumable sample supports allows one platform to be used for the wide range of experiments. Contact us to discuss the full range of capabilities of Poseidon. We can be reached at (919) 377-0800 or contact@protochips.com.

Reference: Images were recorded using a JEOL 3200 FS TEM. Indiana University, Bloomington, IN. PVP-gold nanorods were supplied by Nanopartz, Inc. Loveland, CO

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