Application Note

Poseidon™

Moving Gold Nanoparticles Imaged with Scanning Transmission Electron Microscopy

Reference: Dr. Niels de Jonge, Vanderbilt University of School of Medicine, Nashville TN. For additional details see: E.A. Ring and N. de Jonge, Microsc. and Microanal., 16 , 622-629 (2010)

Introduction

Dynamic behaviors, such as nanoparticle flow, interactions, and self-assembly are an important factor in the development of nanomaterials applications. Poseidon GapSet™ technology contains an integrated spacer layer available in a range of thickness heights to provide a fully customizable platform for controlling liquid flow during *in situ* imaging.

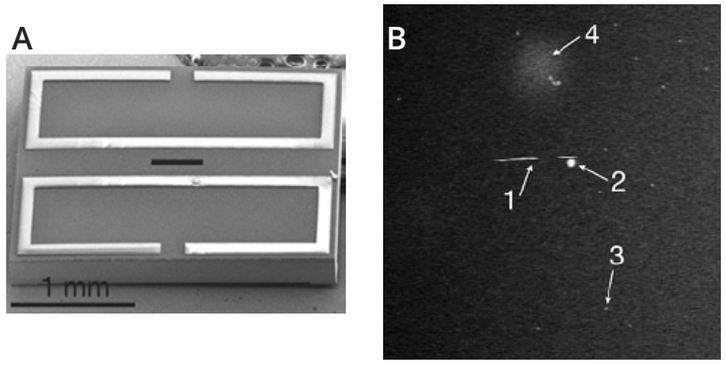
In this experiment, a flowing solution of gold nanoparticles was imaged *in situ* using scanning transmission electron microscopy (STEM).

Experiment

The *in situ* specimen chamber was assembled using a standard, flat E-chip and a 6 µm thick, GapSet E-chip, forming a defined channel for liquid flow. The microfluidic tubing was pre-filled with 10% phosphate buffered saline in water. STEM images were recorded using a Philips/FEI 200 kV CM200 STEM/TEM operating in continuous imaging mode.

The electron beam scan direction was aligned to the long side of the flow cell, such that the liquid flow was parallel to and in the same direction as the scanning beam. A concentrated solution of 100 nm and 30 nm diameter gold nanoparticles in 10% PBS was then introduced using a pump speed of 2 µL/min. Streaks, due to moving particles, were visible in the STEM images several minutes after starting the pump.

Discussion



An SEM image of the GapSet E-chip used to form the microfluidic channel is shown in Figure A. Figure B shows a STEM image of nanoparticle flow. A series of streaks is visible at arrow 1, which presumably are due to a single gold nanoparticle moving to the left. Arrow 2 highlights a stationary 100 nm gold nanoparticle, which was deposited on the silicon nitride window during flow. Several 30 nm diameter gold nanoparticles, such as that seen at arrow 3, are visible throughout the image.

The accumulation of contaminating species can be observed in the region indicated by arrow 4. The rate with which the nanoparticle #1 traveled through the channel was determined to be ~ 0.1 mm/s. Comparisons of the signal intensity of #1 with that of the stationary particles, 2 and 3, indicate that the moving nanoparticle is likely 100 nm in diameter.

Applications

The Poseidon GapSet E-chip design is ideal for imaging a continuous flow of liquid and for the injection of reagents into the system. Contact us to discuss Poseidon's full range of capabilities. We can be reached at (919) 3477-0800 or contact@protochips.com.

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