Observation of Au-nanoparticles in a Graphene Wet Cell

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Abstract High resolution nanoscale imaging is important for research across a vast number of fields from biology to chemistry. Most imaging is done under widely available high vacuum electron microscopy. The high vacuum environment in these machines makes the imaging of liquids challenging under standard techniques. Resolution obtained from silicon nitride membranes is on the order of 20 nm in an SEM with low signal to noise ratio (SNR) [1]. Higher resolution requires the use of Scanning Transmission Electron Microscopes (STEMs) or Tunneling Electron Microscopes (TEM) under high electron dosage which damages fragile biological samples [2-3]. Here we present a graphene wet cell for high resolution imaging of a liquid environment in a standard Scanning Electron Microscope (SEM). We obtain high resolution (<5 nm) SEM videos of moving Au nanoparticles inside the graphene wet cell, surpassing current conventional silicon nitride membranes. SEM characterization instruments such as Energy Dispersive X-ray Spectroscopy (EDX) can also be performed directly in the liquid environment [4]. This is possible due to the transparency and strength of a 2 μm graphene window which can sustain the high vacuum and grounding requirements of a SEM [5]. The graphene wet cell can be easily adapted for study of biological or molecular systems and for nanofluidic flow experiments.

References

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Figures

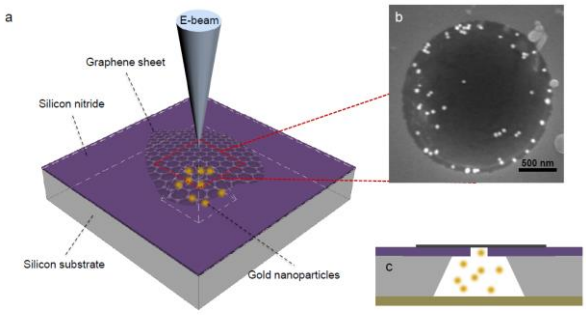

Fig 1: a) A schematic of our graphene wet cell device. b) SEM image of liquid environment through the graphene membrane micropore. c) Schematic of device as viewed from the side. The Au particles are enclosed in the 500 microns fluid reservoir deep between the graphene membrane and kapton tape.

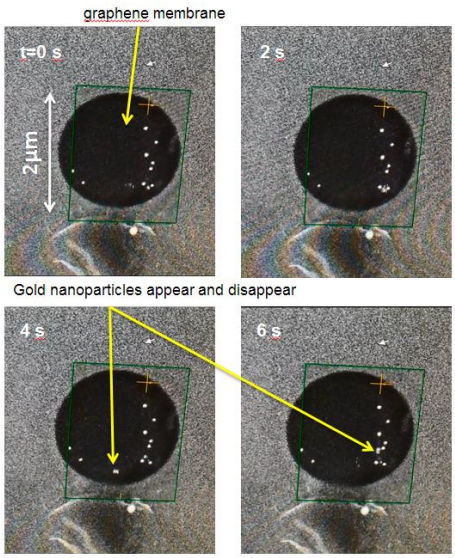

Fig 2: Sequence of SEM micrographs showing gold nanoparticles diffusing in and out of SEM sensing range.