# The imaging properties of polyoxometalate ions on curved graphene

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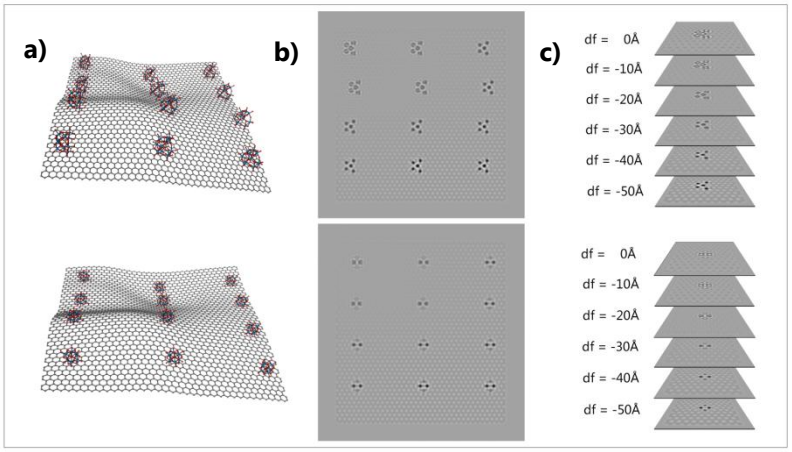
It has recently been demonstrated that aberration corrected transmission electron microscopy (AC-TEM) of polyoxometalate ions (POM's) supported on either Graphene Oxide (GO)[1,2], or within Carbon Nanotubes (CNT's)[3], permits the observation of small structural distortions, and on GO, the visualization of surface interactions. A critical aspect of these studies has been a detailed understanding of the imaging properties of both the POM anions, and also of the specimen supports.

Another important aspect of understanding the image properties of molecular scale species supported on ultrathin carbon monolayers, is their ability to help us understand the local curvature and morphology of the supporting material. Through a detailed understanding of the POM's imaging properties with respect to orientation and defocus, we can use the image contrast as a quantitative measure of the local focusing conditions, and consequently the respective height of the specimen.

To show this, multislice simulations with conditions representative of AC-TEM have been conducted for single POM anions supported on graphene and graphene oxide as a function of defocus, and also on corrugated graphene/ graphene oxide sheets where a similar effect can be observed with the variation in height.




**a) b)** Composite structure model of various POM's on rippled graphene surface. along with multislice simulation showing contrast variation due to local height fluctuations.

**c)** Simulated focal series for POM anions showing expected contrast as a function of defocus.

1. J. Sloan, Z. Liu, K. Suenaga, N. R. Wilson, P. A. Pandey, L. M. Perkins, J. P. Rourke, and Ian J. Shannon, Nano Lett. **10**, 4600 (2010).
2. N. R. Wilson, P. A. Pandey, R. Beanland, R. J. Young, I. A. Kinlock, L. Gong, Z. Liu, K. Suenaga, J. P. Rourke, S. York, J. Sloan, ACS Nano, **3**, 2547 (2009).
3. J. Sloan, G. Matthewman, C. Dyer-Smith, A-Y. Sung, Z. Liu, K. Suenaga, A. I. Kirkland, E. Flahaut, ACS Nano **2**, 966 (2008).