Agilent Technologies

New Low Voltage FE-SEM & AFM Techniques Offer Unprecedented Glimpse into Graphene

Low voltage (<5kV) field emission scanning electron microscopy (LV-FESEM) provides a straightforward imaging technique of energy-sensitive materials with high resolution. For non-conducting samples, coating might be eliminated due to the possible charge equilibrium achieved on the specimen's surface. In this workshop, low voltage imaging of graphene on different substrates will be demonstrated. The secondary electron imaging, backscattered electron imaging and topographic imaging modes were used to study the surface morphologies of graphene samples at a broad range of magnifications. Tuning the beam voltage (down to 500V) was tested as an effective method to control the charging problem caused by insulating substrates beneath the graphene layer. This imaging technique can be used in graphene-related research such as quality check, and impurity identification of engineered graphene materials as well as device fabrication.

Researchers using atomic force microscopy often use optical methods to identify graphene due to its unique optical property. In order to identify graphene using AFM, counting the thickness is the most reliable method. These methods are reliable, but have their shortcomings when graphene layers are grown on an opaque substrate or a substrate with uneven flatness. This presentation will describe using "Frequency Modulation Electro Static Force" technique to study and identify graphenes. The FM-KFM technique reveals the electrical potential variation generated by the contact interface between the graphene and substrate while the dC/dZ signal can clearly differentiate between the graphene and substrate. Combining signal contrast from multiple channels, we will demonstrate AFM's capability to study and identify graphene without optical techniques.