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Surface Charge Effects on the Electro-Orientation of Insulating Nanotubes in Aqueous Electrolytes.[1] SEMIH CETINDAG, Rutgers University, BISHNU TIWARI, DONGYAN ZHANG, YOKE KHIN YAP, Michigan Technology University, SANGIL KIM, University of Illinois at Chicago, JERRY W. SHAN, Rutgers University — While the alignment of electrically conductive nanowires and nanotubes by electric fields in liquid solution has been well studied, much less is known about the electro-orientation of insulating 1D particles, such as boron-nitride nanotubes (BNNTs). Here, we demonstrate for the first time the electro-orientation of individual insulating BNNTs in aqueous KCl solutions under AC fields. Comparison to theory indicates that the observed frequency response is not related to the crossover for Maxwell-Wagner interfacial polarization. Instead, the cross-over frequency in the low-frequency regime scales as the square root of solution conductivity, indicating that alignment is associated with the formation and motion of an electrical double layer (EDL), much like induced-charge electro-osmosis for a conducting particle. However, the mechanism for the formation of the EDL is presumably different for insulating particles like BNNTs as compared to conductors. By varying the surface charge of the particle by changing pH, we show that the alignment rate increases with increasing surface charge, and is likely a result of counter-ion migration and EDL polarization under the influence of applied electric field. Thus, particle surface charge (large Dukhin number) is believed to play a vital role in the electro-orientation of insulating particles in aqueous solutions.

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