The exterior of single-walled carbon nanotube as a molecular conduit

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Single-walled carbon nanotubes (SWNTs) are promising nanoscale conduits that resemble the structure of protein ion channels in biological systems. Molecular transport along the surface of carbon nanotube is known to be highly efficient because of its atomically smooth surface. The material potentially allows for in situ measurement of the transport using inherent near-infrared photoluminescence and Raman scattering. However, only limited amount of information has been available thus far due to experimental challenges. Here we show experimentally the evidence of the ionic transport along the exterior of SWNTs. When an electrical bias is applied to droplets of salty water placed on each side of carbon nanotubes, nanocrystals are formed along the nanotubes. This result is a direct evidence of the exterior transport of ions. Surface analyses show the distribution of cations and anions during the transport. We also investigate using Raman spectroscopy how the transport of ions depends on the diameter and metallicity of nanotubes. Recent studies in this area have largely focused on the interior of nanotubes, but our study suggests there still remain many questions to answer and opportunities to explore in the exterior of nanotubes