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Chemistry Inside Carbon Nanotubes

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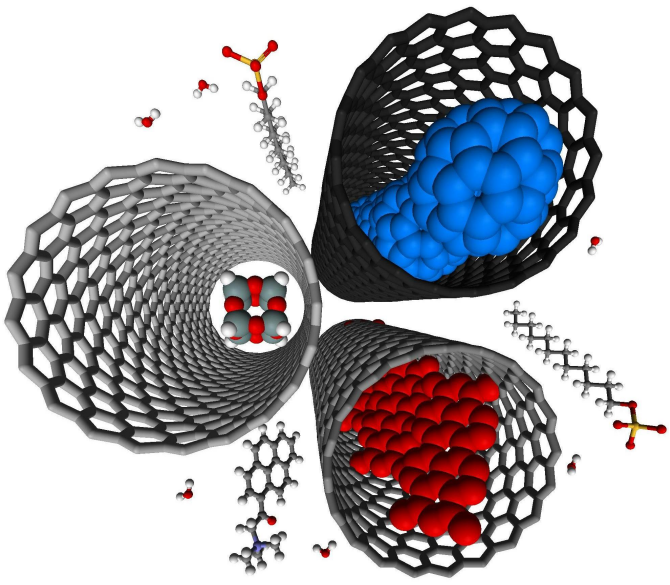

Carbon, being a light element with half-full outer electronic shell, is capable of forming atomically thin, yet mechanically robust structures, such as graphene and single-walled nanotubes (SWNT). In our research, we utilise SWNT as containers for individual molecules and atoms. Because of the low atomic number of carbon (Z = 6), nanotubes are particularly suitable for high resolution transmission electron microscopy (HRTEM) analysis as their contrast is sufficiently low to "see though" them and to visualise individual molecules with atomic resolution. Furthermore, SWNT are very efficient heat and electric conductors, while the chemical reactivity of the interior of carbon nanotubes is extremely low, which protect the structural and the chemical integrity of the molecules during HRTEM studies.

Over the past few years we have discovered and described fundamental rules governing packing [1], orientation [2,3] of molecules in nanotubes using low voltage HRTEM methodology. This approach has been fruitful for unravelling complex chemical transformations in real-time and direct-space, such as formation of metal clusters [4], structural transformations in nanotube sidewalls [5], spontaneous assembly of graphene nanoribbons within nanotubes [6], and transformation of graphene to fullerene [7].

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