

theory for unit cells containing hundreds of atoms was only possible because the helical symmetry was taken into account explicitly in our calculations. The results can be useful for interpretation of experiments, especially on CoMoCat tubes, but also on HiPCo tubes and the inner walls of double walled carbon nanotubes. The phonon dispersion of several larger diameter tubes have also been calculated for comparison. A clear phonon softening with decreasing diameter can be observed.

68**TEM imaging of organic molecules in motion in/on CNT**Masanori Koshino¹ Kazutomo Suenaga² Eiichi Nakamura¹¹ERATO, JST, Hongo, Bunkyo-ku, Tokyo 113-0033, Japan²Research Centre for Advanced Carbon Materials, National Institute of Advanced Industrial Science and Technology (AIST), Higashi, Tsukuba, Ibaraki 305-8565, Japan

We report herein the observation of a single small organic molecule either at rest or in motion interacting with a single wall carbon nanotube (CNT), with near-atomic resolution. Hydrocarbon chains, aromatic rings, amide bond, and other fundamental groups in biology connected with a carborane or C_{60} fullerene tags are visualized during their movements by transmission electron microscopy (TEM), despite the assumed high sensitivity of organic molecules to damage by electron impact, which has discouraged previous explorations of the imaging. The effects of external temperature, electron irradiation, inside or outside of CNT on the observations are discussed based on the TEM observations of acceleration voltage of 120 kV at 293 K and 4K.

69**Linear plasmon dispersion in single wall carbon and the excitation spectrum of graphene**Christian Kramberger¹ Thomas Pichler¹ Ralf Hambach² Lucia Reinning² Erik Einarsson³ Shigeo Maruyama³¹IFW Dresden, Germany²Ecole Polytechnique, Palaiseau, France³Univ. Tokyo, Dept Mech Engn, Japan

We have measured a strictly linear π plasmon dispersion along the axis of individualized single wall carbon nanotubes, which is completely different from plasmon dispersions of graphite or bundled single wall carbon nanotubes. Comparative *ab initio* studies on graphene based systems allow us to reproduce the different dispersions. This suggests that individualized nanotubes provide viable experimental access to the fundamental electronic excitations of graphene, and it validates the use of graphene to understand electronic excitations of carbon nanotubes. In particular, the calculations reveal that depolarization effects cause a mixing of electronic

transitions, including the ‘Dirac cone’, resulting in the observed linear dispersion.

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Ion energy influence on the carbon nanostructuring in C:Ni nanocomposite films

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Nanocomposites are heterogeneous materials wherein the lateral extension of at least one component is lower than 100 nm.[1] They are advanced functional materials whose structural, electronic, and mechanical properties cannot be predicted from the properties of their constituents alone. This is partially due to the presence of interfaces, which occupy a considerable volume fraction of the nanocomposites. Nanocomposites, comprised of metallic nano-particles embedded in a carbon matrix have recently attracted considerable attention,[2]-[4] due to their promising mechanical, optical and magnetic properties. Despite many studies, the mechanisms responsible for the nanostructuring of both constituents are not well understood.

In this study, the influence of the energy of the depositing species in the C:Ni system is investigated. This is achieved by the comparison of the C:Ni film structures grown by ion beam sputtering (IBS) and pulsed filtered cathodic vacuum arc (PFCVA) deposition. The films studied were deposited with substrate temperature in the range (RT-500C) and with Ni contents of 8 at%, 15 at%, and 30 at%. The main difference between the two growth methods is the energy distribution of depositing species which is 1-10 eV for IBS and 100 eV PFCVA. The higher ion energy allows the synthesis of hydrogen free tetrahedral amorphous carbon (ta-C) in Ni-free films. Structural properties of the films were analysed by XRD and wavelength dependent Raman spectroscopy. The structures observed for nickel were correlated with the growth temperature and the nickel concentration and included a low-crystalline, a hexagonal and a fcc phase. Independent of its crystalline structure, Ni catalyses the formation and the long-range ordering of 6-fold aromatic ring structures in the carbon phase. This effect was observed in films deposited by both methods. The higher energy in PFCVA appears to counteract the ordering process, as indicated by the lower I(D)/ I(G) Raman line intensity ratio and by the smaller splitting of carbon D- and G-line compared to IBS grown C:Ni thin films. The higher incoming energy flux also enhanced the formation of new carbon structures with Raman spectroscopic features at 550 and 1100 cm⁻¹ both of which showing a resonance enhancement for visible laser excitation.

1 P. M. Ajayan, L.S. Schadler, P.V. Braun, Nanocomposites Science and Technology, Wiley, (2005).