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Polarized Raman Spectroscopy of Aligned Single-wall Carbon Nanotubes in Strained Composites

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The G and disorder induced D* Raman bands of single-wall carbon nanotubes (SWNT's) aligned by shear flow in a polymer matrix has been measured as a function of uniaxial strain in the matrix. Both the intensity and strain-shift of the D* band vary with the light polarization direction in the plane of the composite film showing that indeed the nanotubes are aligned by this simple method. The polarization dependence of the D* intensity is compared with the G band and with previous measurements on the G and D bands for well aligned SWNT's in air and a *similar* dependence is observed in all cases. Assuming that an *identical* polarization dependence would be observed for well aligned tubes both inside and outside the polymer, we use the 'in air' results to assess the degree of nanotube alignment in the polymer and propose this general method as a useful tool for assessing local alignment conditions in carbon-fibre composites. Measurements of the Raman strain-shift as a function of the polarization direction are consistent with this interpretation, and show that when using nanotubes as a nanoscale strain gauge, it is not necessary to align the nanotubes. This is important because then local strains in all directions in the plane of the polymer film can be assessed simply by changing the polarization direction.