Receiving and Transmitting Light-Like Radio Waves: Antenna Effect in Arrays of Aligned Carbon Nanotubes

We produced optical measurements of random arrays of aligned carbon nanotubes, and showed that the response is consistent with conventional radio antenna theory. We first demonstrated the polarization effect, the suppression of the reflected signal when the electric field of the incoming radiation is polarized perpendicular to the nanotube axis. Next, we observed the interference colors of the reflected light from an array, and showed that they result from the length matching antenna effect. We demonstrated that MWCNTs interact with light in the same manner as simple dipole radio antennas. In particular, they showed both the polarization and the length antenna effect. The first effect was characterized by a suppression of the reflected signal when the electric field of the incoming radiation is polarized perpendicular to the nanotube axis. The second, the antenna length effect, maximizes the response when the antenna length is a proper multiple of the half-wavelength of the radiation. These effects could be used in a variety of optoelectronic devices, such as THz or and IR detectors.

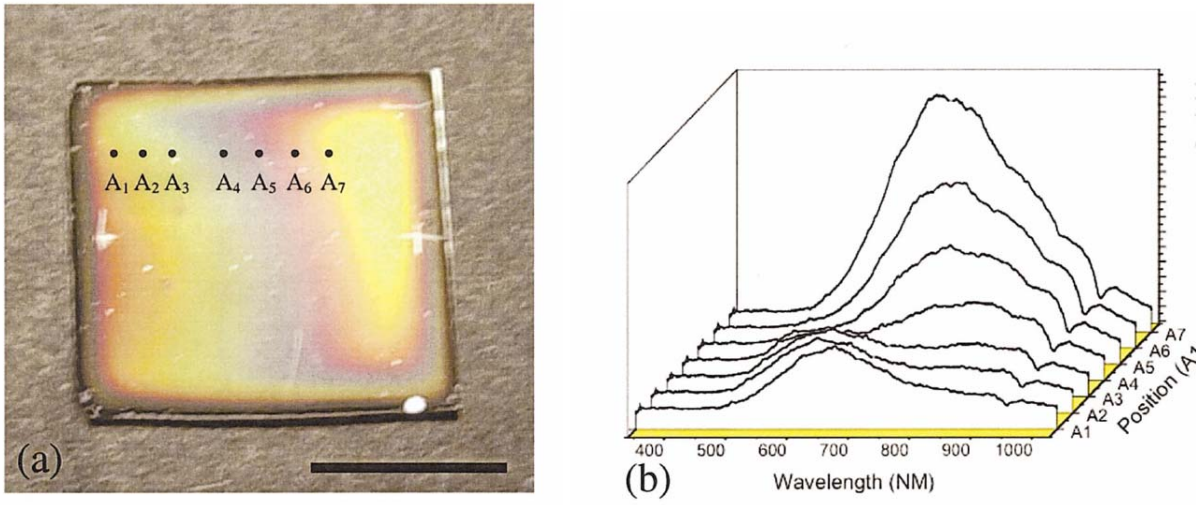

Figure. (Color) Antenna length effect. (a) Interference colors from the random array of MWCNTs. A1–A7 are the selected positions where the length and optical measurements were carried out. Scale bar, 1 cm. (b) Reflected light intensity vs radiation wavelength measured in selected points on the sample shown in (a).

Reference/Publications

Wang, K. Kempa, B. Kimball, J. B. Carlson, G. Benham, W. Z. Li, T. Kempa, J. Rybczynski, A. Herczynski, and Z. F. Ren, "Receiving and transmitting light-like radio waves: Antenna effect in arrays of aligned carbon nanotubes," *Appl. Phys. Lett*., 85, 2607-2609, 2004. As reviewed in *Nature*, by M. S. Dresselhaus, Volume 432, Dec. 2004.

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