Reflectance of Carbon Nanotube Forest metamaterials

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CNT forest of high emissivity, nearly ideal "black-body absorber[1]", is attracting researchers as a candidate material for the future application of high-sensitive sensor, thermal energy storage device[2], and so on. Recently, metamaterials, electro-magnetic circuit to the incident EM-wave, opened a method to design desired optical properties. We recently reported CNT forest metamaterial in infrared and visible region in order to increase optical and thermal absorbance utilizing FIB nanofabrication [3, 4].

In this paper, metamaterials composed by 1D anisotropic refractive index material of CNT Forests, and the effect of nano-sized patterning on the optical and thermal properties are discussed. Figure 1 shows calculated UV-Vis-IR spectra of vertical- and parallel-aligned metal-nanorod CNT forests to the Electric field (E_z) of incident EM wave propagating in the x direction, showing good correspondence to the experimental results[5] in Fig. 1(d-g). Components of perpendicularly aligned CNTs, which were parallel to the E_z of EM wave, increased reflectance in longer wave length region. Alignment of CNTs had an important role to improve absorption on the metamaterial patterns. Patterning shape effect of CNT forest metamaterials[3-5] will be also discussed in detail.

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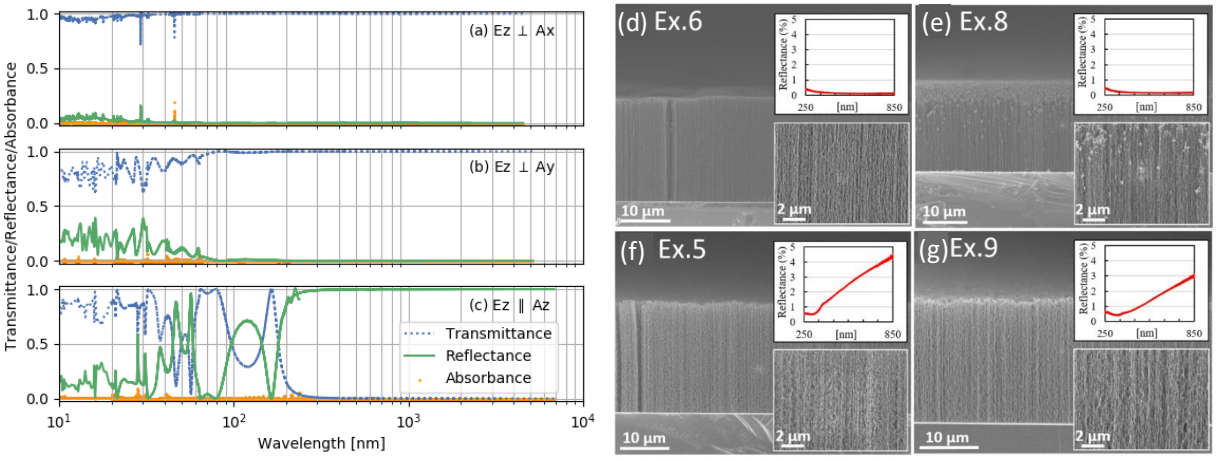

Fig.1 (a-c) Calculated Transmittance, reflectance and absorbance spectra by meep FDTD program for the metal-nanorod CNT forests. E_z of EM wave was perpendicular to (a) *x*-axis and (b) *y*-axis of CNT alignment, and (c) parallel to z-axis of CNT alignment. (d, e) Highly vertically aligned CNT forests exhibiting low reflectance in 10-degree specular reflectance [5]. (f, g) Low-degree aligned (wavy) CNT forests showing higher reflectance in longer wavelength [5].