Graphene, Fullerenes and Nanotubes in the Space

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We present a series work about carbon dust in the space, which includes the theoretical calculation of IR emission of graphene, C_{24}, and the possible detection of infrared emission of planar C_{24}, and also Fullerenes C_{60} close to the HII region candidate IRAS 17450–2759 toward Sgr B2. An absorption spectrum of carbon nanotube (CNT) in the space is also presented here. The IR emission spectrum of graphene from theoretical calculation showed unusual IR emission features at $\sim$ 6.6, 9.8 and 20 μm. We have placed an upper limit of $\sim$ 5 ppm of C/H on the abundance of graphene in the diffuse ISM. Subsequently, we have searched for characteristic IR emission features of C_{24} toward the high-mass star formation region (HMSFR), Sgr B2, and detected possible IR emission from C_{24} at $\sim$ 6.637, 9.853 and 20.050 μm for the first time in HMSFR. Those three IR emission features are also accompanied by the characteristic IR emission of possible C_{60}. We also calculated the absorption spectrum of (5, 0) CNT, the smallest CNT, using the discrete dipole approximation, which exhibits four spectral features, peaking at $\sim$ 0.3, 0.5, 0.9, and 2.9 μm. The survey of C_{24}, C_{60} and C_{70} toward 16, 000 Spitzer spectra is on the way. The observation toward some planetary nebulae that had detected C_{24} or C_{70} had been done by using Purple Mountain Observatory (PMO) 13.7 m millimeter telescope.