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The field sensors made of graphene and carbon nanotube quantum dots

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An interesting part of the electromagnetic field spectrum which is enclosed between 0.5 THz and 100 THz belongs to the THz domain. There are many reasons why the T-rays are interesting. Exploiting of the THz waves (T-rays) provides considerable advantages in many different areas of human activity, including the medicine, space research, the defense and security. For instance, various chemical inorganic and organic molecules have resonances in the oscillation and rotation spectra within the THz domain. For such reasons, reflection and transmission THz spectral characteristics permit a remote detecting, identification, and chemical analysis of an analyte of interest. An additional benefit of T-rays is their sub-millimeter wave length. Therefore the T-rays easily penetrate through thin layers of closes or plastic covers. This property of the THz spectral analyzer has a strong potential for detecting of concealed weapon, hidden explosives, or toxic chemicals. However an immediate detecting of the THz waves represents a non-trivial task. A basic physical reason why the T-ray detecting is problematic is that the energy of a T-ray photon is much lower than a conventional light photon. Therefore the T-ray sensor elements must be exceptionally sensitive to triggering on the low-energy photons. Another complication is that the T-rays are not reflected by conventional mirrors nor they are focused by conventional lenses. Absence of appropriate T-ray mirrors and lenses makes the control of T-rays quite tricky. Creating and development of the T-ray optical devices represents another tremendous task.

In my talk I characterize available T-ray detectors and spectral analyzers. A special attention is paid to basic physical mechanism and principles of the T-ray sensing. Along with the bolometric and non-linear T-ray sensors, I also address graphene and carbon nanotube quantum dot devices. Because the T-ray photon energy is relatively low, the design technology and fabricating of such nano-sensors requires special approaches which will be presented with focusing on major details. A list of critical requirements to the quantum dot devices includes not only common characteristics like the contact resistance, charge transfer length, or operational temperature, but also the nanotube diameter and chirality, as well as the shape and width of the graphene stripe edges. I discuss the ways how to increase the degree of intrinsic coherence in the carbon nanotube and graphene sensors. In this way one makes them much more capable comparing to the quantum dots which were being fabricated from regular semiconductors.

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