Universität Augsburg
Anwenderzentrum Material- und Umweltforschung

Graphene based voltage tuneable emitter and amplifier of terahertz radiation

Background

Terahertz (THz) radiation (frequencies from approx. 0.1 to 10 THz) lies between microwaves and infrared portions of the electromagnetic spectrum and is potentially very important for a variety of applications. It penetrates many different materials (clothes, paper, carton, wood, plastics), can be used for identification of many organic molecules (which have their "fingerprints" within THz range), for diagnosis/treatment of human illnesses (e.g. imaging of healthy/ill tissues), for spectroscopy of space (THz spectra of remote stars and galaxies) and for telecommunications. However, this part of the spectrum suffers from a lack of simple and cost-effective electronic devices (generators, detectors, mixers, etc). Available devices are often bulky and/or very expensive. Graphene – a recently discovered one-atom thick nanomaterial – has unique physical characteristics which open up a number of opportunities to use it in electronic applications.

Invention

The invented few-atomic-layers-thin flat graphene-based emitter is able to emit high power radiation (estimated as approx. 0.5 W/cm²) with the frequency covering the range from approx. 0.1 up to 30 THz. The operating frequency can be tuned by an applied DC voltage, the operating temperature can be close to room temperature, and the efficiency of the device is estimated to be at approx. 1-2%. Since the whole device is only a few atomic layers thin, it is almost invisible (transparent) and bendable which may allow the focusing of high power radiation in small spatial areas. A modification of the emitter-type design may serve as an amplifier of radiation combined with a flat distributed antenna.

Commercial opportunities

Security: screening of passengers and luggage in airports and other security points, anti-terrorist tasks (seeing through walls, identification of hidden weapons, including plastic bombs or explosives), non-violating identification of the suspicious content of letters and packages (with the chemical analysis of the content), identification of drugs. Chemical and pharmaceutical industry: in-situ chemical analysis of produced chemical materials and medicines.
Medicine: early diagnosis of cancer and other illnesses. Telecommunications. Space astronomy.

Developmental status

The idea and specific designs are developed; development of a prototype is planned.

Origin
University of Augsburg

Industrial sector(s)
Security:
Full body scanner (airport, police, post, banks)
Chemical and pharmaceutical industry:
Spectroscopic analysis of organic molecules
Medicine:
Detection of epithelial cancer
Materials science:
non-destructive materials testing, quality control
Communication:
High-altitude telecommunications, wireless data transmission with high bandwidth
Spaceflight:
Measuring and communication systems

Keywords
Terahertz radiation, terahertz gap, terahertz emitters/sources, amplifiers, mixers, imaging

Patent situation
European patent granted
US patent application filed

Offer
Cooperation, license, transfer of patent rights

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