

Development of a Stand-off Distance System for Detecting Hidden Hazardous Materials

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Events over the past decade have demonstrated the need for more efficient security screening and substance detection against increasing numbers of threats. This project develops a special sensitive and inexpensive stand-off distance system using terahertz (THz) waves with GaTe and InSe crystals for detecting hidden hazardous materials at long distances. For the first time the possibility of generation and detection of THz waves with GaTe and InSe crystals was investigated. GaTe and InSe were prepared by melting elemental mixtures in evacuated quartz tubes. The starting mixtures were placed in tubes, which were pumped down to 1 Pa, sealed and heated at ~ 5 K/min with a holding every 60 K. Synthesis was carried out for 5 h at a temperature ~ 40 K above the melting point of crystals; they were cooled, held there for 10 h. In our experiment we used Laser – Ti:Sapphire (10 fs), THz time-domain Spectrometer include: beam splitter and absorptive ND Filter. During our research we demonstrated that the crystals have no analogs in having such a large electro-optic coefficient, high damage threshold, suitable transparent range, a low absorption coefficient and birefringence properties, therefore we use them for detection of broadband THz waves. Based on the crystals' low absorption coefficients, the analysis demonstrated that our system is approximately three times more effective than standard methods. In addition it exhibits unique potential for a label-free detection of DNA, explosives and chemical materials at a distance (stand off). Furthermore, it was recently demonstrated that this system can be used to detect cancer. Our system is more accurate and sensitive, so we will be able to detect hazardous substances in more than 30-40m, consequently it can protect humans from harmful effects of these materials.

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