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Check Red Blood Cells Concentrations of a Blood Sample by Using Photoconductive Antenna

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Abstract : Terahertz (THz) range lies in the area between 0.1 to 10 THz. The process of generating and detecting THz can be done through different techniques. One of the most familiar techniques is done through a photoconductive antenna (PCA). The process of generating THz radiation at PCA includes applying a laser pump in femtosecond and DC voltage difference. However, photocurrent is generated at PCA, which its value is affected by different parameters (e.g., dielectric properties, DC voltage difference and incident power of laser pump). THz radiation is used for biomedical applications. However, different biomedical fields need new technologies to meet patients' needs (e.g. blood-related conditions). In this work, a novel method to check the red blood cells (RBCs) concentration of a blood sample using PCA is presented. RBCs constitute 44% of total blood volume. RBCs contain Hemoglobin that transfers oxygen from lungs to body organs. Then it returns to the lungs carrying carbon dioxide, which the body then gets rid of in the process of exhalation. The configuration has been simulated and optimized using COMSOL Multiphysics. The differentiation of RBCs concentration affects its dielectric properties (e.g., the relative permittivity of RBCs in the blood sample). However, the effects of four blood samples (with different concentrations of RBCs) on photocurrent value have been tested. Photocurrent peak value and RBCs concentration are inversely proportional to each other due to the change of dielectric properties of RBCs. It was noticed that photocurrent peak value has dropped from 162.99 nA to 108.66 nA when RBCs concentration has risen from 0% to 100% of a blood sample. The optimization of this method helps to launch new products for diagnosing blood-related conditions (e.g., anemia and leukemia). The resultant electric field from DC components can not be used to count the RBCs of the blood sample.

Keywords : biomedical applications, photoconductive antenna, photocurrent, red blood cells, THz radiation
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