Nanoparticle-Enhanced Terahertz Imaging of Breast Cancer Phantoms

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The use of carbon-based nanoparticles as a contrast agent for Terahertz (THz) imaging was investigated. THz imaging has been shown to effectively distinguish between cancerous and healthy tissue by infiltrating ductal carcinoma and lobular carcinoma of the breast. However, due to the highly absorbing nature of water in fresh tissue, the images of healthy fibroglandular tissue often appear similar to that of cancer tissue. Additionally, imaging of THz phantoms developed of infiltrating ductal carcinoma, fibroglandular, and healthy fatty tissue illustrate the ability of THz to penetrate fatty tissue and the additional challenge of detecting cancer that has been embedded fibroglandular tissue. As a result, the use of nanoparticles is investigated here for its potential to increase the contrast between cancer and healthy tissue in THz imaging of breast cancer.

Nanometer-scale onion-like carbon (OLC) has been shown to interact with terahertz signals and can be functionalized to selectively attach to breast cancer cells. THz imaging is first performed on fibroglandular phantoms alone as well as cancer phantoms with and without OLC, showing good enhancement in the reflected THz image when OLC is added. Additional THz imaging is performed on tumor model constructions consisting of the cancer phantom containing OLC adjacent to the fibroglandular phantom compared to the same combination without OLC in the cancer phantom. The resulting THz reflection images clearly show enhancement of the detected signal of infiltrating ductal carcinoma containing OLC adjacent to the fibroglandular phantom, which can be developed to further improve THz imaging of breast cancer in the future.