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Label-free Raman Imaging to Monitor Breast Tumor Signatures

JOHN CIUBUC, University of Texas at El Paso, Department of Biomedical Engineering, GIULIO FRANCIA, KARLA PARRA, Department of Biological Sciences, MARIAN MANCIU, Department of Physics, EMMA SUNDIN, Department of Biomedical Engineering, KEVIN BENNET, Mayo Clinic, Division of Engineering, FELICIA MANCIU, University of Texas at El Paso, Department of Physics, Border Biomedical Research Center, El Paso TX 79968 USA — Methods built on Raman spectroscopy have shown major potential in describing and discriminating between malignant and benign specimens. Accurate, real-time medical diagnosis benefits from substantial improvements through this vibrational optical method. Not only is acquisition of data possible in milliseconds and analysis possible in minutes, but Raman allows concurrent detection and monitoring of all biological components. Besides validating a significant Raman signature distinction between non-tumorigenic (MCF-10A) and tumorigenic (MCF-7) breast epithelial cells, this study reveals a label-free method of assessing overexpression of epidermal growth factor receptors (EGFR) in tumor cells. EGFR overexpression gives rise to Raman features associated with phosphorylated threonine and serine, and modifications of DNA/RNA characteristics. Investigations by gel electrophoresis reveal EGF induction of phosphorylated Akt, agreeing with the Raman results. The analysis presented is a vital step toward Raman-based evaluation of EGF receptors in breast cancer cells. With the goal of clinically applying Raman-guided methods for diagnosis of breast tumors, the current results lay the basis for proving label-free optical alternatives for prognosis of the disease.

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