2021 ACG-IRG Pilot Grant

Colorimetric Metasurfaces for Quantitative, On-Chip and Label-Free Cancer Tissue Diagnostics

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Abstract:

The structural remodeling and detrimental proliferation of fibrous living tissue is a hallmark of disease progression that can affect organs across the human body. Structural changes in the extracellular matrix play a critical role in the progression of various cancers (Figure 1a),[1–6] yet quantitative visualization of tissue microstructure in the tumor microenvironment is not yet possible in clinical, pharmaceutical, and in-situ settings.[7] This proposal puts forth a powerful new technology to image microstructural properties in biological tissue that will open avenues for more effective cancer diagnoses and treatments. For example, recent studies have shown that the geometric arrangement of collagen fibers around tumor margins can act as a quantitative marker of cancer stage,[8] where tangential and radial alignments can distinguish localized from invasive cancers. Further, high collagen densities within tumor tissue can indicate patient resistance to standard treatment.[9] Unfortunately, the great potential of collagen structural order as a precise, biophysical marker in cancer diagnostics remains largely unexplored, due to the lack of clinically-compatible optical technology. Imaging innovation to incorporate tissue microstructure in cancer assessment would pave the way for transformative diagnostics, drug development, and improved understanding of disease progression.