MAR12-2011-008494

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Tissue Refractive Index Fluctuations Report on Cancer Development

GABRIEL POPESCU, University of Illinois at Urbana-Champaign

The gold standard in histopathology relies on manual investigation of stained tissue biopsies. A sensitive and quantitative method for *in situ* tissue specimen inspection is highly desirable, as it will allow early disease diagnosis and automatic screening. Here we demonstrate that *quantitative phase imaging* of entire unstained biopsies has the potential to fulfill this requirement. Our data indicates that the refractive index distribution of histopathology slides, which contains information about the molecular scale organization of tissue, reveals prostate tumors. These optical maps report on subtle, *nanoscale morphological properties* of tissues and cells that cannot be recovered by common stains, including hematoxylin and eosin (H&E). We found that cancer progression significantly alters the tissue organization, as exhibited in our refractive index maps. Furthermore, using the quantitative phase information, we obtained the spatially resolved scattering mean free path and anisotropy factor g for entire biopsies and demonstrated their direct correlation with tumor presence. We found that these scattering parameters are able to distinguish between two adjacent grades, which is a difficult task and relevant for determining patient treatment. In essence, our results show that the tissue refractive index reports on the nanoscale tissue architecture and, in principle, can be used as an intrinsic marker for cancer diagnosis.

[1] Z. Wang, K. Tangella, A. Balla and G. Popescu, *Tissue refractive index as marker of disease,* Journal of Biomedical Optics, in press).
[2] Z. Wang, L. J. Millet, M. Mir, H. Ding, S. Unarunotai, J. A. Rogers, M. U. Gillette and G. Popescu, *Spatial light interference microscopy (SLIM),* Optics Express, 19, 1016 (2011).
[3] Z. Wang, D. L. Marks, P. S. Carney, L. J. Millet, M. U. Gillette, A. Mihi, P. V. Braun, Z. Shen, S. G. Prasanth and G. Popescu, *Spatial light interference tomography (SLIT),* Optics Express, 19, 19907-19918 (2011).
[4] Z. Wang, H. Ding and G. Popescu, *Scattering-phase theorem,* Optics Letters, 36, 1215 (2011).
[5] G. Popescu *Quantitative phase imaging of cells and tissues* (McGraw-Hill, New York, 2011).
[6] H. F. Ding, Z. Wang, F. Nguyen, S. A. Boppart and G. Popescu, *Fourier Transform Light Scattering of Inhomogeneous and Dynamic Structures,* Physical Review Letters, 101, 238102 (2008).