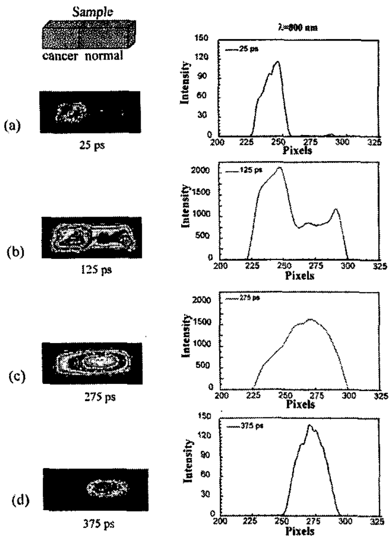

CFL4 Fig. 1. Time-sliced transillumination images of the breast tissue sample described in the text for gate positions of (a) 25 ps, (b) 125 ps, (c) 275 ps and (d) 375 ps are shown in the left frames. Spatial profiles of the integrated intensity distribution along the same horizontal area of all four images are shown in the corresponding right frames.

played in Fig. 1(d). The distinction between the cancerous and normal regions are highlighted in the 25-ps and the 375-ps images.

We attribute this difference in the relative light transmission between the normal and the cancerous human breast tissues to the higher scattering of light by the normal tissue. Photons transiting through the normal region scatter more and come out later compared to those transiting through the cancerous region. We observed similar light transport characteristics of normal and cancerous breast tissues in several samples from different patients. Similar light transmission characteristics were also observed for normal and cancerous tissues from the tongue. An exception was observed in the case of a breast tissue specimen from a 61 year old patient with infiltrating lobular carcinoma.[3] The surgical pathology report described the tumor as showing 'very severe, even bizarre, cytologic atypia.' The variation of light transport characteristics through tumors at different stages of development need to be correlated with histological characterization to develop a detailed understanding of the observed behavior.

Results of a spectroscopic imaging experiment on the sample described above are displayed in Figs. 2(a)–2(d). The salient feature of the figures is that the ratio of light intensity transmitted through the cancerous tissue to that through the normal tissue decreases from 3.0 at 1210 nm to 1.3 at 1300 nm. Similar spectroscopic behavior was observed in tissues from other patients. The differences in spectroscopic images together with those in time-sliced images promise a basis for diagnostic optical imaging of lesions in accessible parts of human body.

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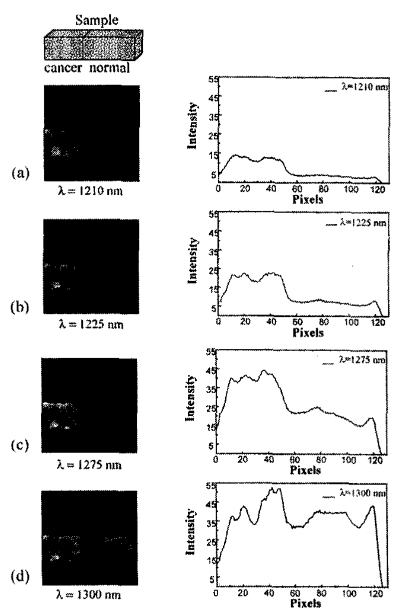

CFL4 Fig. 2. Spectroscopic images (left frame) and corresponding spatial intensity profiles (right frame) of the sample measured at (a) 1210 nm, (b) 1225 nm, (c) 1275 nm, and (d) 1300 nm.

1. For a brief review of optical imaging techniques see S.K. Gayen and R.R. Alfano, "Emerging optical biomedical imaging techniques," Opt. Phot. News **7**(3), 17–22 (1996).
2. S.K. Gayen, M.E. Zevallos, M. Alrubaiee, J.M. Evans, and R.R. Alfano, "Two-dimensional near-infrared transillumination imaging of biomedical media with a chromium-doped forsterite laser," Appl. Opt. **37**, 5327–5336 (1998).
3. S.K. Gayen, M.E. Zevallos, B.B. Das, and R.R. Alfano, "Time-sliced transillumination imaging of normal and cancerous breast tissues," in OSA TOPS volume on "Advances in Optical Imaging and Photon Migration," edited by J.G. Fujimoto and M.S. Patterson, **21**, pp. 63–66, Optical Society of America (1998).

CFL5 11:30 am

Near-infrared blood flow and oxygenation measurement in deep tissues

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By combining diffuse photon-density wave method and diffuse correlation method into one probe, we can measure local blood flow and hemoglobin oxygenation changes in an organ or tumor as functions of treatment or stimulation.

CFL6 11:45 am

The use of polarized light for the measurement of glucose concentration and the study of multiple scattering in turbid chiral media

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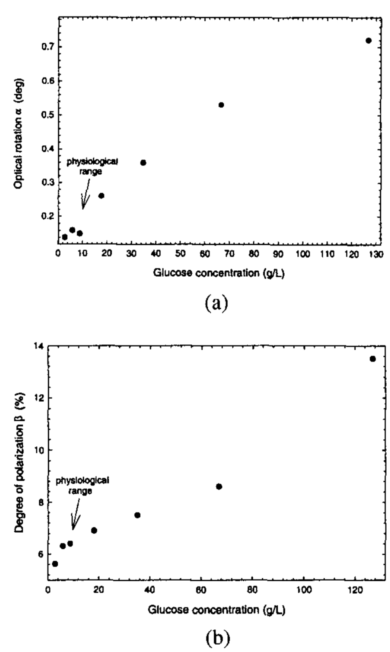
One would think that polarized light launched into multiply scattering sample would escape completely depolarized. This, however, is not so—depending on the scattering properties of the sample, the initial polarization state, and source-detector geometry, the diffusely remitted light may exhibit a significant surviving polarization fraction.[1] This polarization data may reveal useful optical, compositional and spatial information about the densely scattering sample.

The behavior of light polarization in a multiply scattering model system composed of 1-μm-diam polystyrene microspheres in water is studied in the presence of dissolved glucose. This is because an important influence on polarized light propagation and scattering is the presence and amount of optically active (chiral) molecules in the turbid sample, for example glucose.[2] The signal detection and analysis is performed with a polarization modulation device. Used with a synchronous detection via lock-in amplification, this system allows sensitive measurements of a small polarized fraction in a predominantly depolarized background, such as the case for diffusely



CFL6 Fig. 1. (a) Optical rotation versus glucose concentration for a turbid sample of polystyrene microspheres (optical thickness ~85), detected at 90° to the incident beam. (b) Degree of polarization versus glucose concentration for the sample in Fig. 1(a).