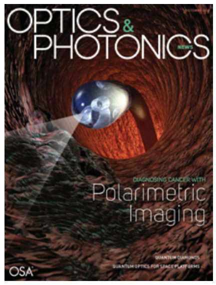
Polarized light and cancer



Thank you for the interesting article on polarimetric imaging for cancer diagnosis (OPN, October 2012).

The experimental setup and results are quite interesting, but the article does not appear to correctly connect scattering and polarization theory. The authors' claim for small scatterers is that "backscattered light is less depolarized when the incident light is linearly rather than circularly polarized."

Size really has nothing to do with the greater circular depolarization. For backscattering, all randomly oriented particles depolarize more in circular polarizations regardless of particle size (Appl. Opt. **47**, 3795 [2008]). This is a result of integrating a single particle's scattering matrix over all possible azimuthal orientations.

Within the Rayleigh regime, depolarization generally increases with particle size. For example, nitrogen molecules are aspheric, but due to their small size, they are only weakly depolarizing at visible wavelengths. However, the amount of asphericity and index contrast also play a role in determining the particle's depolarization (Opt. Lett. **20**, 1356 [1995]). Perhaps a more likely reason that the researchers can discount larger scatterers such as cell nuclei from the depolarization signals is their being nearly spherical. (Spherical particles do not depolarize within the single scattering approximation.) Size alone certainly does not rule out depolarization, or greater circular depolarization, by larger cellular structures.

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THE AUTHOR REPLIES: We appreciate Matthew Hayman's opinion about our article. His comments might be relevant for single scattering by independent particles. Both of his cited references deal with a single scattering regime, which is quite common in lidar or radar polarimetric experiments.

However, biological tissue is a multiply scattering medium. In such media, we have to solve the problem of radiative transfer in order to find the coefficients of the tissue's Mueller matrix.

Measurements of diffuse backscattering Mueller matrices of highly scattering media and corresponding Monte Carlo simulations showed the variation of M44 values with the size of scatterers (Opt. Exp. **1**, 441 [1997]); Appl. Opt. **39**, 1580 [2000]). The characteristic length of depolarization in multiply scattering media depends on the initial state of polarization (linear or circular) and on size of particles (Phys. Rev. E **49**, 1767 [1994]).

The researchers Xu and Alfano described the mechanism of circular depolarization due to multiple scattering by particles of a large size or high refractive index in 2005 (Phys. Rev. E **72**, 065601). So, the claim that size has nothing to do with greater circular depolarization is not correct in our case.

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