Low-cost tissue simulating phantoms with tunable, wavelength-dependent scattering properties (Conference Presentation)

Rolf B. Saager, Alan Quach, Rebecca A. Rowland, Melissa L. Baldado, Adrien Ponticorvo, Anthony J. Durkin, Beckman Laser Institute and Medical Clinic (United States)

ABSTRACT

Tissue-simulating phantoms provide the opportunity to evaluate the performance of optical and spectroscopic instruments under controlled experimental conditions. Recent efforts have advanced phantom fabrication methods to provide more tissue realistic phantoms, both in terms of a) incorporating absorbing agents that more faithfully mimic in vivo tissue chromophores spanning visible and near infrared regimes and b) accounting for multi-layer tissue structures with distinct optical properties. The spectral scattering properties in these phantoms, however, are typically based only on a single scattering agent, thereby locking the spectral scattering properties to a single particle size distribution. However, in both healthy tissue as well as pathologic tissue, regions of distinct and differentiated scattering may be present. With differing mean size and distribution of scattering objects in these tissue regions, the relative wavelength-dependent scattering spectra may vary. For example, partial thickness burns exhibit significant cellular damage and collagen denaturation that will significantly alter the wavelength-dependent scattering properties resembling large Mie-like scatterer distributions in both visible and near infrared regimes.

We present a low-cost method to fabricate silicone tissue-simulating phantoms with tunable scattering spectra properties that span visible and near infrared wavelengths. We use optical polishing agents (white aluminum oxides powders) at various grit sizes to approximate Mie scattering across multiple mean particle sizes. Mean particle sizes used in this study range from 17-3 micron. The optical properties of these phantoms are verified using an integrating sphere in combination with inverse adding-doubling methods. The tolerances of this fabrication method will be discussed.

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