

Popular Science

Are you curious about why ink is black? Do you really know what the word "black" means? Have you ever thought of the reason why the sky looks blue? To answer all the questions from the aspect of optical spectroscopy, these phenomena can be explained by the interaction between light and matter. More specifically, ink is black because it has a high absorption coefficient over a broad wavelength band, so we see it as "black". The sky looks blue because it scatters the blue light more than the red light, since blue light has a shorter wavelength. The absorption process describes the ability to absorb light, while the scattering process describes how much light is scattered into other directions. Similar to these phenomena, the absorption and scattering processes of biological tissue are also of great interest. This thesis project, derived from the absorption and scattering processes, extends to many applications in bio-medical imaging.

Various spectroscopy techniques using optical light, ultrasound and other methods, have been developed for medical imaging. Before utilizing these imaging systems in real biological tissue, there should be standards for system control. Thus, phantoms are made to validate an imaging system. Rather than the phantoms in the opera, the word "phantom" refers to the artificial model mimicking the properties of real biological tissue. They are much safer and more economically and environmentally friendly than using real biological tissue in laboratory tryouts. This thesis project gives a summary of materials for phantoms with similar optical and acoustic properties as those of real tissue.

Another part of the thesis is centered on photoacoustic effects. When biological tissue is illuminated by laser light, the absorbed energy causes temperature rise and results in volume expansion and pressure change. However, the tissue will then be cooled down by exchanging heat with the surroundings and the pressure variation results in ultrasound emission. This ultrasound signal contains information of the tissue and can be collected and analyzed to reconstruct photoacoustic images. Photoacoustic imaging (PAI) is a promising method among medical imaging applications.

This thesis aims to make a deeper dive into medical imaging applications and pre-clinical diagnosis. Hopefully, a wide range of knowledge of bio-medical phantoms can be

learned from this master thesis.