We use a commercial product, intralipid (IL) as our scattering agent. It is a milky white liquid consisting in part of soybean oil (20%) suspended in water (80%). A small amount of egg yolk phospholipids are included to stabilize the suspension.

We model the data using solutions of the diffusion equation to obtain the light absorption coefficient, μ_a and scattering mean free path, l^*. Although it may appear that a single pulse would suffice in determining these parameters, this is not the case. The pulses themselves are described by relatively featureless functions. Because space of parameters that match the model functions to the data describes a χ^2 surface without a sharp minimum at the best fit solution, parameters fit to a single pulse are ambiguous, and are useful only as estimates. We overcome these problems by using multiple curves at different source – detector separations which provides additional constraints for the fit. All the data are analyzed simultaneously for each scatterer concentration.

DISCUSSION

Light propagation within the sample is described by the diffusion equation:

$$\frac{\partial u}{\partial t} = (D\nabla^2 u - \mu_a c)u \tag{1}$$

where u is the density of photons, μ_a is the absorption coefficient, and $D = cl^*/3$ is the photon diffusion constant. The solution in free space is

$$u = \frac{1}{(4\pi Dt)^{3/2}} \exp(-r^2/4Dt - \mu_a ct). \tag{2}$$

The directional photon current $J_{\hat{r}}$ gives the actual flux through the detector aperture. The current given by Fick's law, $J = -D\nabla u = J_{+\hat{r}} - J_{-\hat{r}}$ represents the *net* current only, not the directional current. with the result

$$J_{\hat{r}} = \frac{c}{4}(u - \nabla_{\hat{r}} u/h). \tag{3}$$

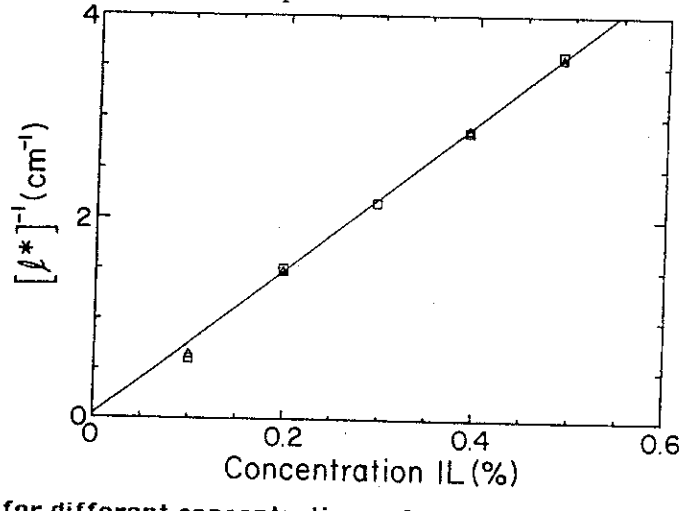
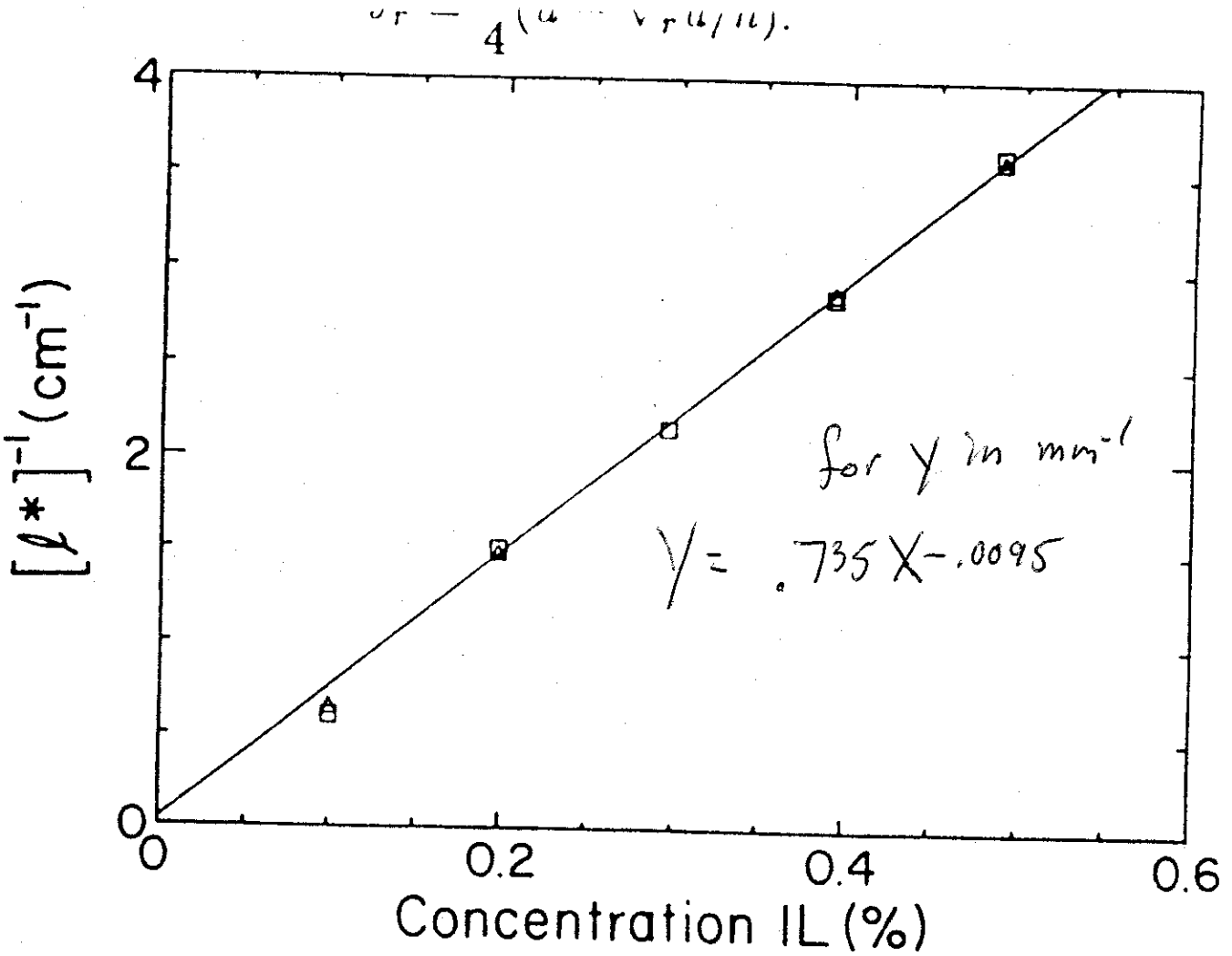


Fig. 1: $1/l^*$ for different concentrations of scatterers in the infinite volume case. Squares represent data taken with detector perpendicular to source; triangles represent data taken with detector facing source.

In Figure 1 we show the scattering mean free path l^* determined separately for various concentrations of



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Fabrication and characterization of highly scattering tissue phantoms.

Haberland U., Yibing S. and Blazek V.

An increasing number of medical devices are based on the detection of light scattered out of biological tissues. To compare and investigate theses devices reliable, long term stable and highly scattering solid tissue phantoms are helpful. So far suspension of polystyrene spheres, intralipid solutions and dilute milk has been used but these liquid phantoms vary considerably with time.

The paper outlines the fabrication of solid polyester phantom. The scattering properties can be varied by incorporating different amounts of silica spheres into the resin. Furthermore absorption is achieved by adding measured quantities of a dye into the phantom. Finally the resin is cast in different moulds according to the application. The phantom can easily be machined in any ordinary working shop.

The measurement techniques determining the absorption and scattering coefficients of theses phantoms are based on double- integrating-spheres. A Monte Carlo simulation which incorporates the spheres and the scattering media is used to relate the measured sphere efficiencies to the optical properties of the phantom.

Editor: Claes Asker