

Study about Important on why the Phenomenon of Light Propagation in Microstructure on Anisotropy is Important

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Abstract

Here we want to explain the phenomenon of light propagation in a subtle structure the information of which is shown here. So here we investigated the phenomenon dependence of light diffusion in human dentin on microstructure. The main scatter tubes are found in the dentin, which can be estimated to be shaped like long cylinders. So here we calculated the scattering of electromagnetic waves through an infinitely long cylinder and applied the results to the Monte Carlo code which took into account multi-scattering and also simulated light propagation in a dentin slab. It is therefore important to understand the diagnostic application of light in medicine and its effects. As well as the microstructure of the tissue on light propagation, this knowledge can enable preliminary investigation. This can lead to changes in the structural tissues which may also increase the chances of successful treatment. Moreover, the dependence of light diffusion on microstructure has also been studied in the literature. Which have been investigated on successful large tissue volumes in cells but only in very few. Therefore, it can be said that in addition to the applied models, it was assumed that the phenomenon of diffusion of light is isotropic, i.e. the properties of optics are not dependent on the direction of the photon. However, this is not true for many tissue types, for example, muscle, ligaments, tendons, skin, enamel and dentin. Thus the spread of anisotropic light in these tissues is due to their alignment (cylindrical). So in this study we show you that light diffusion in the dentin, the bone-like part of the tooth, It can be successfully explained by its microstructure and that light diffusion is also significant anisotropic. Dentin has main scatter ducts, which can be used as supply channels for the metabolism of dentin's organic matrix.

Keyword: Anisotropic, microstructure, Light propagation, Reflection, Scattered, Cylinder, Light diffusion.

INTRODUCTION

So in this study we show you that light diffusion in the dentin, the bone-like part of the tooth,

It can be successfully explained by its microstructure and that light diffusion is also significant anisotropic. Dentin has main scatter ducts, which can be used as supply channels for the metabolism of dentin's organic matrix [1].

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The tubules extend from the pulp to the enamel-dentin junction as shown in Figure 1 here. Thus the tension can be imagined from the three-dimensional arrangement of the tubules here. So here we can make measurements on human dentin using laser scanning microscope (LSM). Which Figure 2 shows the size of the reflection. It can therefore be seen that the tubules have a cylindrical form with approximately parallel directions, the

diameter of the tubules being about 2 μ m. Thus, here it can also be seen to be scattered through a single tube. Also here the angle between the photon and the direction of occurrence of the cylinder axis is known as θ . Thus his calculations here show that the scattered photons form a cone and the cylinder as the axis of a semicircular cone as shown in Figure 3. This could mean that the event of angle = 90° can be turned into a cone plane for angle θ and One has to emphasize that there is no scattering in the direction perpendicular to the direction of the cylinder. Not even in other directions. As well as the distribution of intensity with the cone is given in Figure 4 for the cylinder. Thus the following parameters were used for this, which mainly includes the refractive index of cylinder neon = 1.33 and the diameter of the cylinder $d = 2 \mu$ m. And the wavelength of the event light $\lambda = (3633/n_t)$ nm from the tissues around the cylinder $n_{out} = 1.52$ [2, 3].

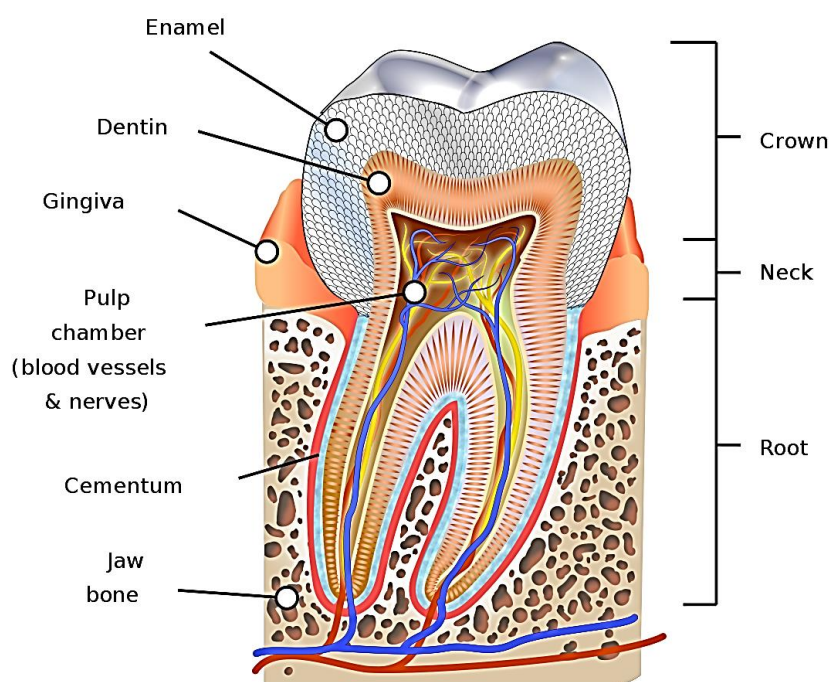


Figure 1. Scheme of the tooth including dental tubules.

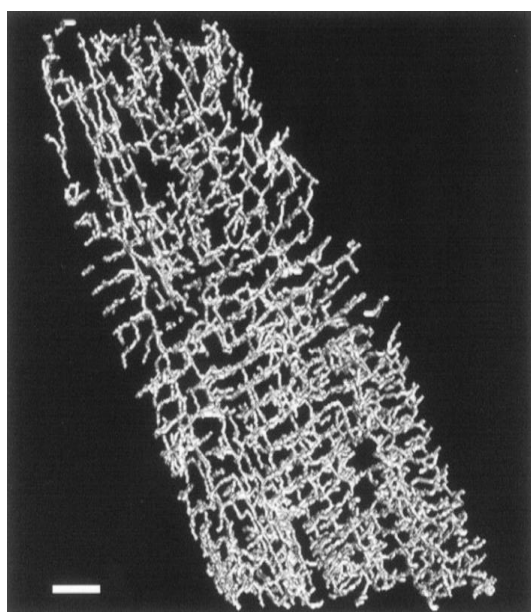


Figure 2. LSM reflection picture.

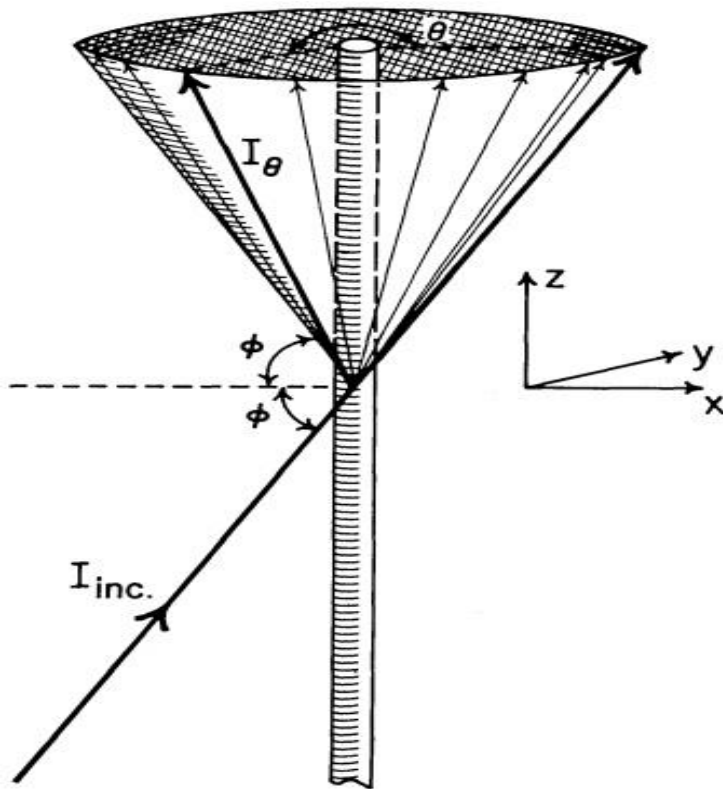


Figure 3. Light Scattering from Long Thin Glass Cylinders at Oblique Incidence.

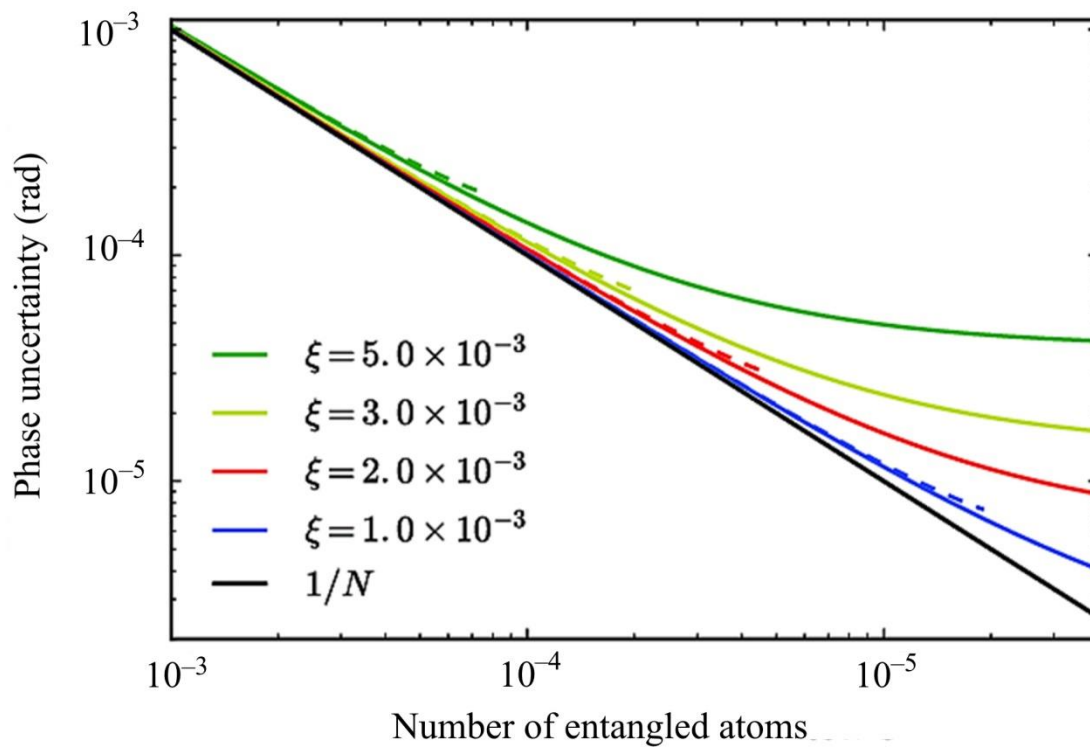


Figure 4. Phase function for different ξ -values.

Thus from the above parameters shown here only the garland is not easily obtained; But in that case, however, this amount of uncertainty may not strongly influence the results. Figure 5 shows that phase = 90° and phase functions for three different reversals [4].

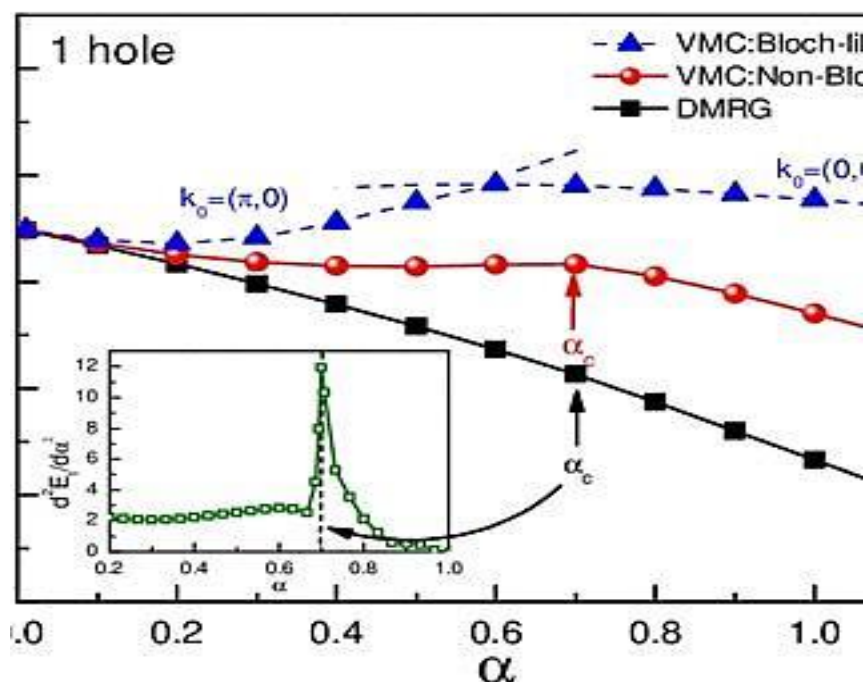


Figure 5. Phase function for different refractive indices outside the cylinder.

Here we use the given dentin slab to calculate the light diffusion Concentrations of tubules, as well as we programmed the Monte Carlo simulation code, which was applied and Scattering results and multi-scattering by a single cylinder were considered. As well as detail, launching the photon into the dentin slab and then, between the direction of the event angle photons and cylinders were calculated. After that, the 'single cylinder' phase also works. Use this value-value and scattering coefficient as well as the scattering angle Scattered lengths. And the calculation was also done using the scattering coefficient,

$$\mu_s = Q_{scat} dcA \quad (1)$$

As shown in the formula above where Q_{scat} is the scattering efficiency obtained by calculating 'single scattering' and $CA = 4.5 \times 10^4 \text{ mm}^{-2}$ a typical value for the density of 2 dental tubules (number per field) we have noticed that both Q_{scat} and both s on Based on For $\Xi = 90^\circ$ And we can also get the above cylinder properties from $Q_{scat} = 3.15$ 'single cylinder'. Thus, the scattering coefficient is 284 mm^{-1} . So, we have to consider multi-scattered photons for the slab we also have here for thin dentin. So the absorption coefficient here is assumed to be zero because it is much smaller than the scattering coefficient and it does so with no significant results effect. It first calculates the scattering interaction and then repeats the calculations until the photon is transmitted or sent into consideration. Freshening equations on slab boundaries, the place where the transmitted photons are created an on-screen event. In the Monte Carlo simulation we have not considered the polarization effects here. So we used this principle to compare this with goniometric experiments. Two specimens were also ground in it and polished to a thickness of about 20 μm . The tubules were parallel or even oriented and are perpendicular to the slab surface. So in addition, 200 was a sample with a thickness of masamide, whose tubules had a 30° angle relative to the sample surface [4, 5].

The transmitted and hidden light was an on-screen event, which was also imaged on a CCD camera. It can be seen in Figure 6. In which the distance between the slab and the screen, was much greater than and the area on the boundary of the slab where the photons were transmitted. Thus, the experiment delivers were resolved as two-dimensional angular i.e. goniometric, scattering data (Figure 7). Dentin was the sample. The teeth were surrounded by water to mimic the natural environment. Figure 6 shows Monte Carlo simulations (left column lum) and measured scattering. In

which the pattern was obtained for a slab that was cut parallel to the direction of the tubules and its thickness: 30 μm . And to explain the intensity of scattering the corners involved. The pattern is shown opposite the angle shown. The direction of the scattered photon and between S. The incidence angles of the laser beam relative to the direction of the tubules were also examined by rotating the normal direction dentin sample three differently on the screen. Gaussian distribution with a standard deviation of 4° was considered for the directions of A. Tubes in the calculation (can be compared to Figure 3). Theoretical and experimental results. See similar main characteristics of transmitted light is the scattering pattern at $\Xi = 80^\circ$ slightly curved form, which is more pronounced for $\Xi = 60^\circ$ and, in particular, $\xi = 40^\circ$ (Figure 4). These results can also be understood qualitatively by considering the scattering by a single cylinder thus theoretically; they are due to the intersection of a scattering cone [6–8]

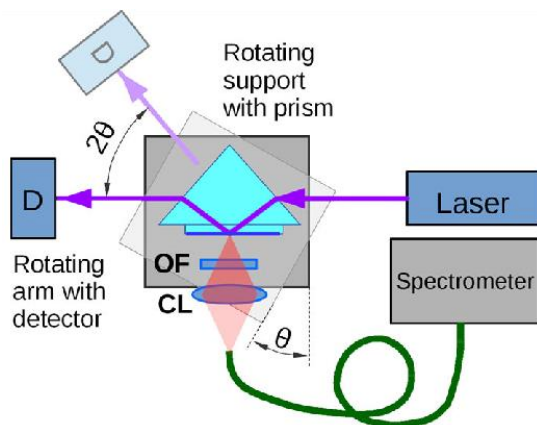


Figure 6. Experimental set-ups for measuring the angularly resolved reflectance.

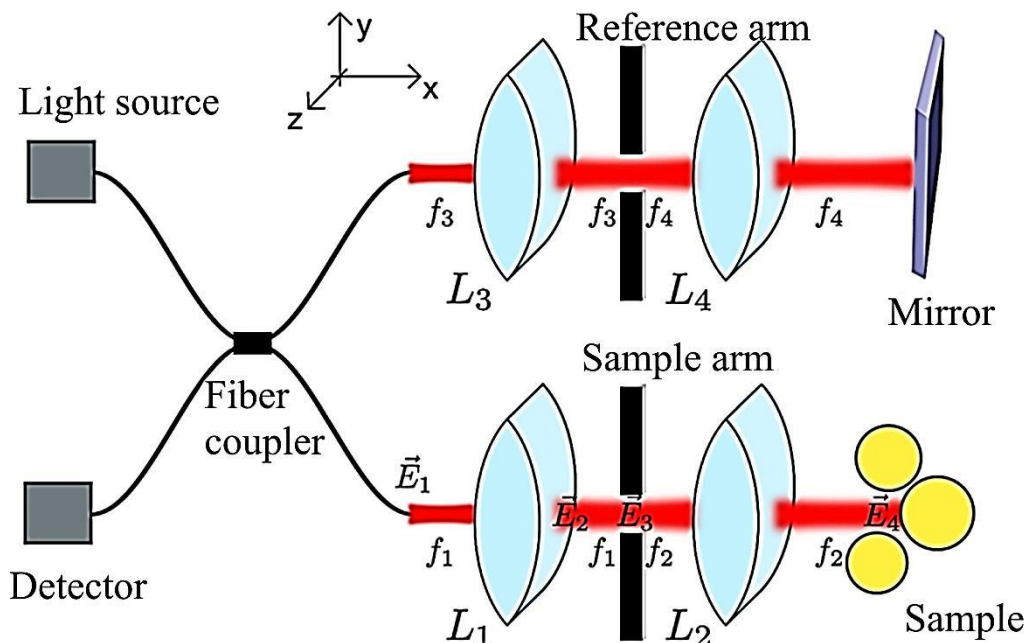


Figure 7. Two-dimensional simulation of optical coherence tomography.

The same optical properties were used for the thin slab in the Monte Carlo simulation, but the standard deviation for Gaussians was increased by increasing the direction distribution of tubes to 7° , as large variations in tubular direction are expected in the Gear sample. There are features of experimental scattering patterns although the anisotropy is not that large. The light transmitted from the thin slab, 200 μm thick specimens, still shows accentuation, anisotropic light diffusion. Figure 6

shows the Monte Carlo simulation and its comparisons. Experiments for slabs with a thickness of 200 μm , whose tubes had an angle of 30° relative to the sample surface. And there were two criteria. In the first of these, the incident light was perpendicular to the sample surface. We second, the curved form of the scattering pattern disappeared until the sample was rotated. Here Figure 3 shows the ring structure of the obtained scattering pattern. The light spot was also taken light microscopy picture and then we calculated whether scattered patterns can occur as seen in this distribution of tubules (Figure 8). We considered each tubule as a scattering center and also determined the position Tubules in the figure. Thus the time-averages for each direction to obtain the intensity of the scattered waves scattered from all the tubes, being squared and scattered. Thus in the end, the intensity was multiplied by the scattering function of a circular hole with a diameter of Tubes. Thus the results were fairly average and are shown in it. Azimuthally average intensity has also been shown Curves of themed data [9–11].

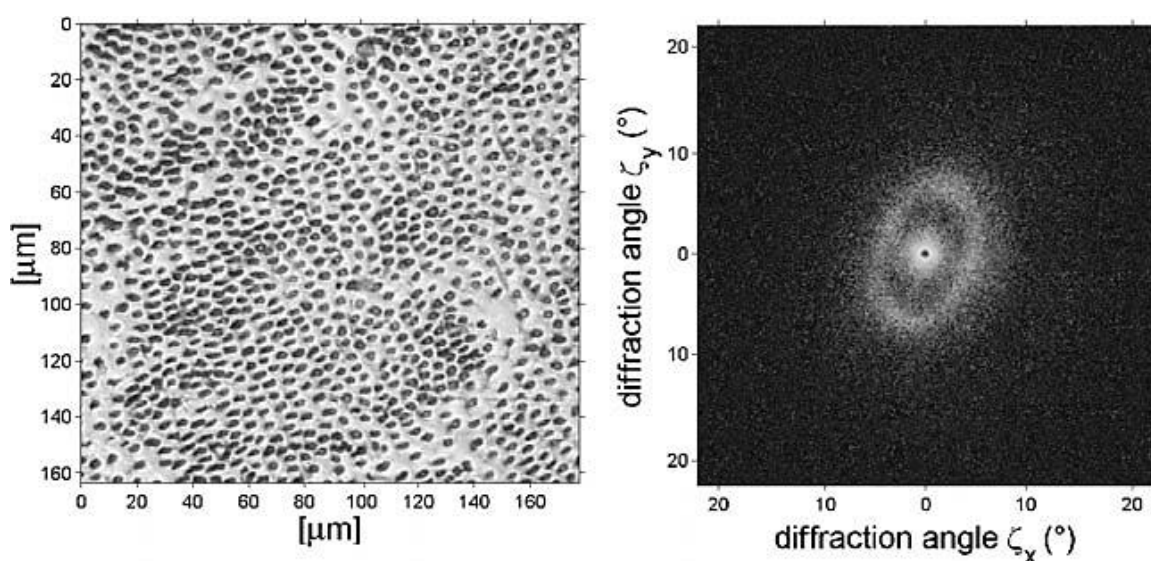


Figure 8. Diffraction by a thin dentin slab. (a) Light microscopy picture of the tubules. (b) Measured diffraction pattern.

CONCLUSION

Here we have shown in its summary that light diffusion in dentin can be explained by it and microstructure. Scatters other than tubules, for example mineral crystals, can also. Distribution of tubules is required to provide for the Montecarlo simulation. It also found that the diffusion of light into dentin is significantly anisotropic. It is only three-dimensional to calculate the diffusion of light into large dentin volumes and can be easily integrated into the model by adding an isotropic component to the phase function. In the literature there is anisotropic light scattering in dentin however, it was argued that it is caused by disruption, but not by waveguide effects or explained we have shown, however, that it is caused by scattering through cylindrical shaped tubes. Thus Dentin Nickel et al. described an anisotropic model for light diffusion in the skin for tissues other than that. And they used a simple heuristic formula for angle-based scattering coefficients to calculate as well as spread light across the skin using the Monte Carlo simulation. Thus here is the conclusion of our study of isotropic models that are generally applied to describe and the light propagation of biological tissues is not valid for dentin. Thus for example, if the optical properties of a dentin slab, which is cut from an angle relative to 45° and The directions of the tubules are measured by the standard method of unified field, No one receives any diffuse forgiveness, the reason being that all the light is found scattered in the front half-space. Thus, it is concluded that the scattering coefficient of highly scattered dentin is zero. Moreover, for anisotropic tissues it is not sufficient to perform an angle-resolution. Commonly considered as tissue assumed in the literature. Finally, we would like to emphasize here that the model presented in this study is not limited to dentin. And it can also be used for all tissues.

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