SURFACE ROUGHNESS EFFECTS ON LIGHT DETECTION PERFORMANCE IN MICROSCOPY SYSTEMS

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1. ABSTRACT

In microscopy applications, the quality of the image is affected by the overall light detection performance of the optical sensor (e.g., the CCD camera). One crucial parameter of the aforementioned performance is the reflectance of light which becomes more complicated in case of granular structures [1]. In the present study, the modification of Fresnel's formulas though the influence of surface roughness was estimated considering the following parameters: (i) light wavelength (400-700 *nm*), and (ii) size of surface roughness in the range 10 - 50 *nm*). The influence was found to be more dominant at lower values of roughness.

2. MATERIALS AND METHODS

The overall light photon reflectance was estimated using Fresnel's formulas and by taking into account the following S_C factor which depends on the sample's granular surface, given by the following equation [2]:

$$S_c = 1 - \exp\left[-\left(\frac{4\pi n\delta}{\lambda}\right)^2\right] \quad (1)$$

where δ is the surface roughness expressing the area of surface irregularities profile per unit of length, λ is the light wavelength and n is the refractive index of the medium. Values of *Sc* near to unity imply reflectance similar to that of surface smoothness.

3. RESULTS

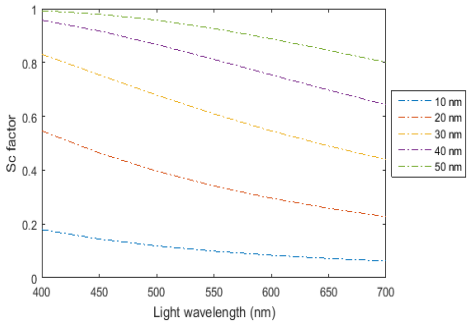

Figure 1: The variation of *Sc* factor as a function of light wavelength

Figure 1 illustrates the variation of *Sc* factor as a function of light wavelength (400 – 700 *nm*). Estimations are shown particularly for surface roughness 10 – 50 *nm* (step 10 *nm*). Results showed that the effect of surface roughness was more dominant at low sized irregularities. In particular, for the lower case (10 *nm*) the *Sc* factor was found to vary from 0.18 down to 0.06 , while for the higher case (50 *nm*) was found to vary from 0.99 down to 0.80 (considering light wavelength: 400 – 700 *nm*)

4. REFERENCES

[1] P. F. Liaparinos, "Optical diffusion performance of nanophosphor-based materials for use in medical imaging," *J. Biomed. Opt.* **17**, 126013 (2012).
[2] A. Roos and D. Ronnow, "Diffuse reflectance and transmittance spectra of an interference layer: 1. Model formulation and properties," *Appl. Optics* **33**, 7908-7917 (1994).