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Modeling and simulation of laser beam through laser polymeric materials

Malik Sajjad Mehmood
University of Engineering and Technology, Pakistan

Photon distribution and its correlation with collected diffuse reflectance and transmittance from UHMWPE are investigated from 200 nm to 800 nm. The scattering coefficients s, absorption coefficients a in cm-1 with Kubelka Munk Model (KMM) in correlation with measured values of diffuse reflectance and transmittance experimentally and found that these coefficients are higher at lower wavelength regions. This is attributed to void space in PE, C=C poly-unsaturation and high values of refractive index mismatch. The total attenuation coefficient t and effective attenuation coefficient eff were determined from extracted values of scattering coefficients s, absorption coefficients a while the penetration depth   in mm were estimated while using eff. The penetration depth in the region ranging from 680 nm to 780 nm with a peak value of 75±1.5 mm at 700 nm was obtained and attributed to the lowest values of a i.e. 0.042 cm-1, forward directed scattering behavior of UHMWPE and almost constant values of s in this region. The accuracy of obtained optical parameters is validated theoretically using Monte Carlo method while using extracted optical parameters as an input for Monte Carlo code and found that theoretical results are in good agreement with experimental one. Furthermore, simulation of photon distribution as a function of depth and radial position shows that majority of photon for lower wavelength are absorbed close to surface i.e. maximum penetration depth for 300 nm incident beam is approximately 0.02 cm and 0.05 cm for 800 nm incident beam, respectively.

msajjad.82@gmail.com