Supporting information for

Characterization of the scattering and absorption of colored zein colloids in optically dense dispersions

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Number of tables: 0

Supporting information 1: TEM images of silica particles from all the synthesis steps

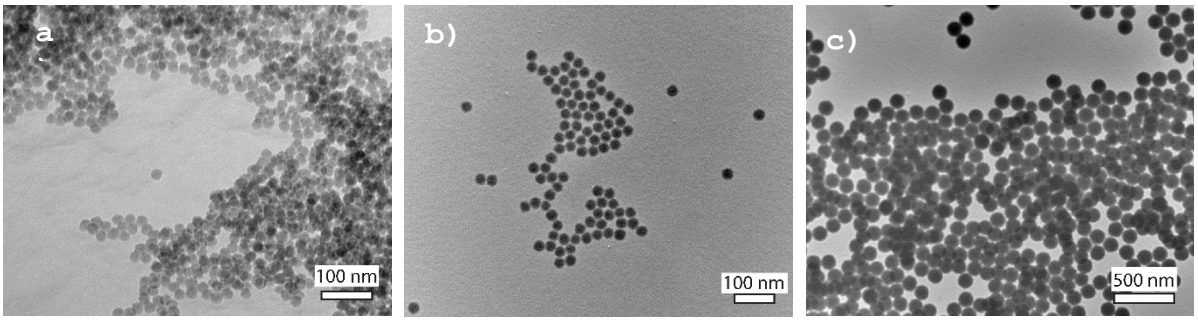

Figure S1. *TEM images of silica particles. Particles resulting from the core synthesis (scale bar is 50 nm) particle size is approximately 26 nm (a), the first growth step (scale bar is 100 nm) after which the particle size was approximately 55 nm (b), and the final growth step (scale bar is 500 nm) after which the particles were approximately 128 nm (c). Particles from the final growth step were used for further experiments.*

Supporting information 2: Method & results for refractive index matching for silica particles

The RI of silica was determined by refractive index matching. First, solutions are prepared by mixing two solvents with different refractive index ratios.[22] The RI region used here is around n_D = 1.45, since for Stöber silica n_D values ranging from 1.43 to 1.462 are reported in literature[23,24] and for these type of silica particles a similar range is expected, although a different synthesis route was used. For this purpose, the RI's of several ratios DMSO in 1-pentanol (vol%) were determined at 550 nm and 21°C (n_{550}^{21}). With a refractometer (Atago 3T) the n_D^{21} and the corresponding Cauchy's equations of these solutions were determined.[25] Then, the transmittance of DMSO and 1-pentanol mixtures containing particles was measured on a UV-Vis spectrophotometer (HP 8953A). A maximum is reached when the refractive indices match. To do this, 5 mL of a 2.17 wt% particle dispersion in water was transferred to a glass vial and the water was evaporated by placing it on a hot plate at 80°C for 16 hours. The particles were re-dispersed in 5 mL 1-pentanol by sonication, after which 0.5 mL of the stock dispersion of particles and various volumes of DMSO and 1-pentanol were transferred to separate vials to obtain a range of particle dispersions in different 1-pentanol/DMSO ratios. Absorption spectra of these solutions were measured at 21°C to determine the transmittance at 550 nm.

Results

In Figure S2a the refractive index at 550 nm and 21°C (n_{550}^{21}) was plotted as a function of the vol% DMSO in 1-pentanol and a linear fit was made. This relationship was used to find the refractive index of the silica particles. Then the transmittance at n_{550}^{21} of particle dispersions with media with different refractive indices was plotted and fitted using a quadratic equation, the fit had an R^2 of 0.9864. The refractive index was determined from the maximum of the transmittance: n_{550}^{21} = 1.453, see Figure S2b.

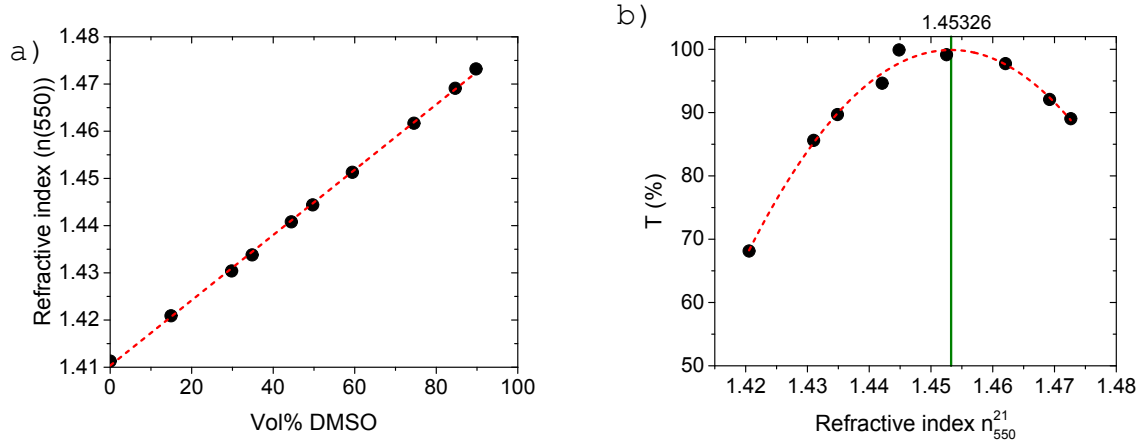

Figure S2. *In (a) the refractive index of silica particles at n_550^21 is plotted as a function of the vol% of DMSO in 1-pentanol. A linear equation was fitted to the data (red dotted line). In (b) the transmittance at n_550^21 was plotted as a function of the refractive index in the medium. The black dots correspond to measurements of dispersions of particles in DMSO/1-pentanol mixtures with different refractive indices. A quadratic equation was fitted to the data (red dotted line) to determine the refractive index of maximum transmittance: n_550^21= 1.453.*

Supporting information 3: Fitting curves obtained by total transmission experiments

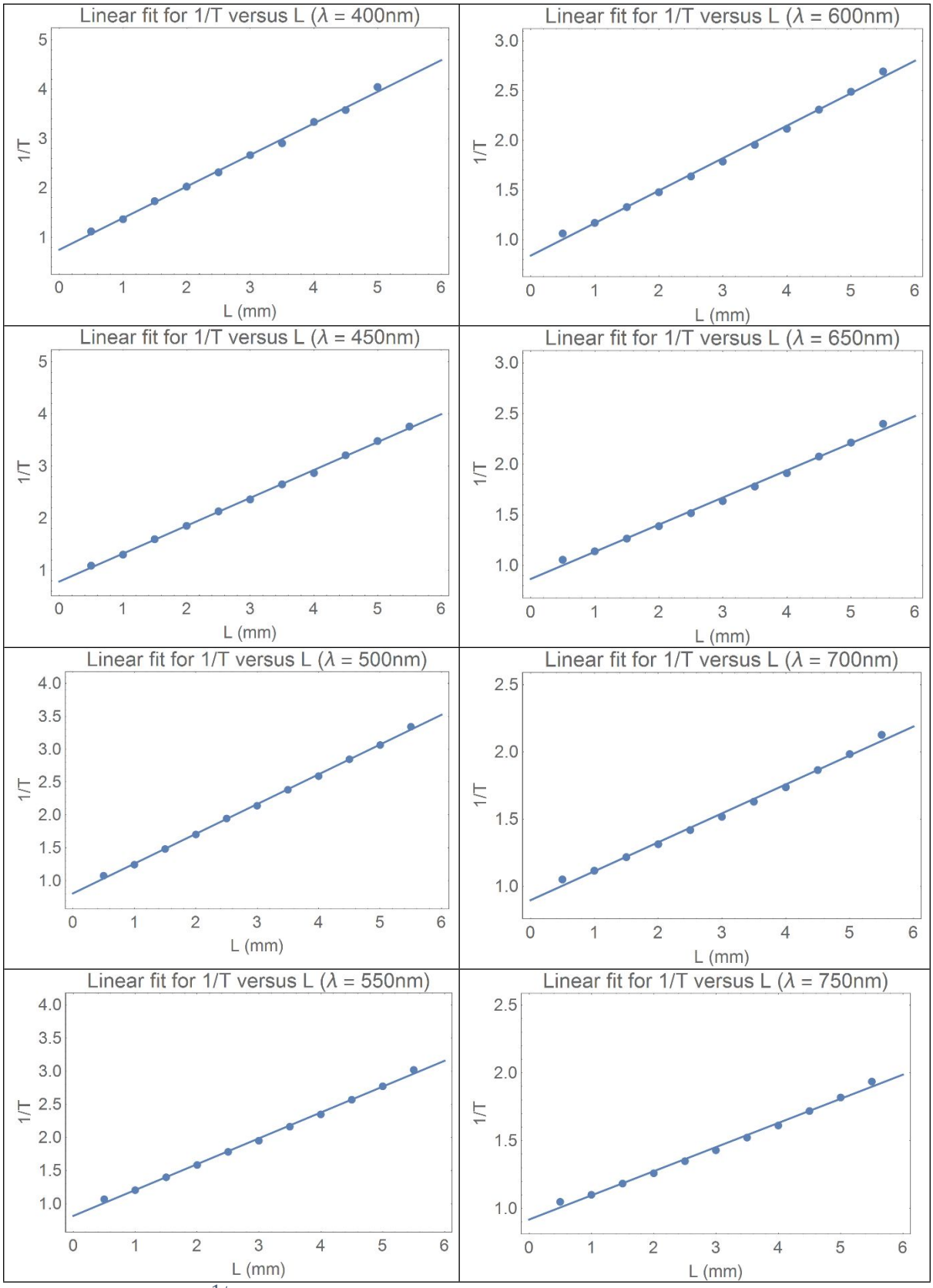

Figure S3: *Linear fit of the* $1/T$ *vs.* L *plot for silica particle dispersions, path-lengths measured were ranging from 0.5 to 5.5 mm and wavelengths between 400 and 750 nm.*

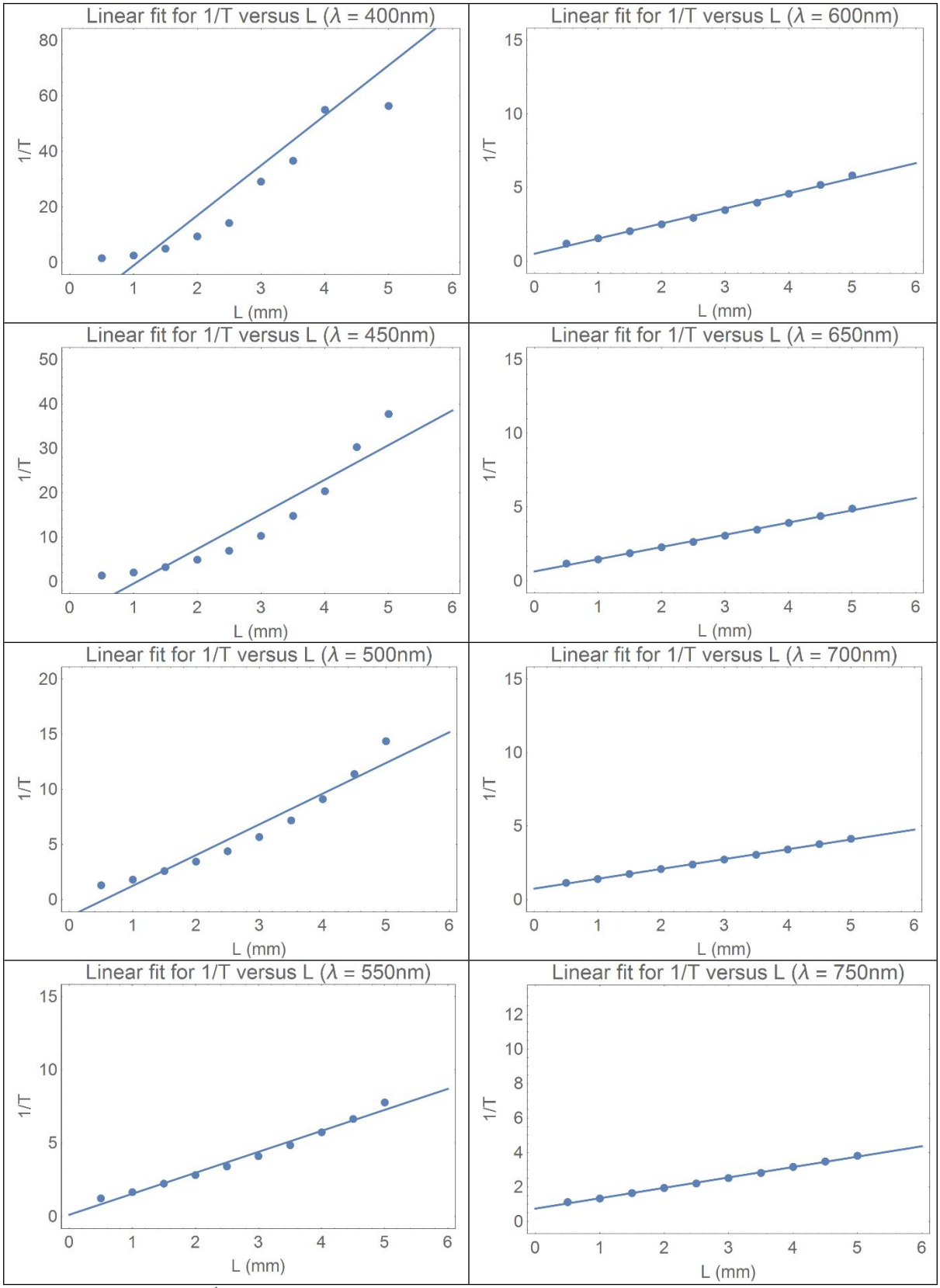

Figure S4: *Linear fit of the* $1/T$ *vs.* L *plot for white zein particle dispersions, path-lengths measured were ranging from 0.5 to 5.0 mm and wavelengths between 400 and 750 nm. Deviation from the linearity is observed from 550 to 400 nm, this is a region where absorption starts for these white zein particles.*

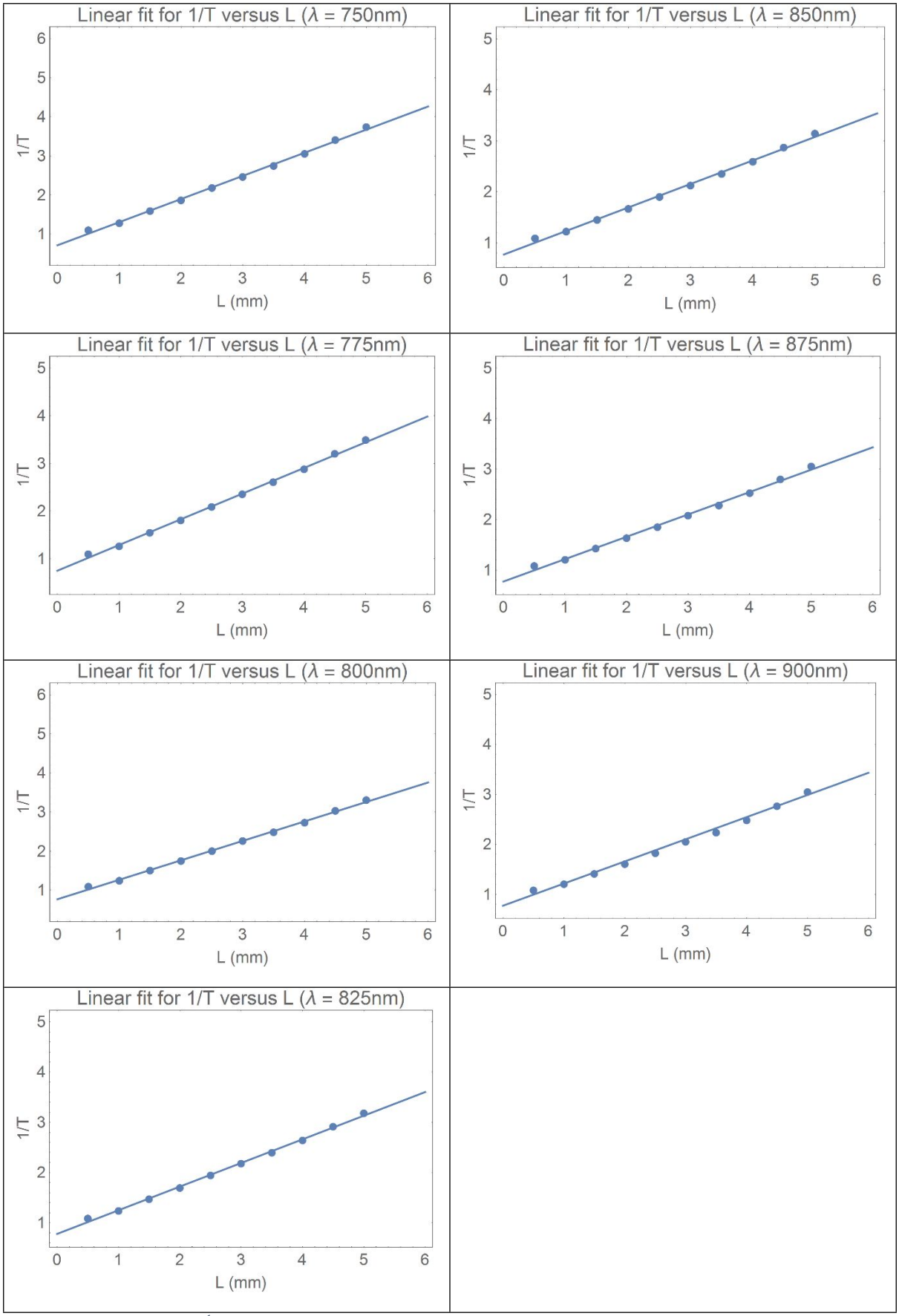

Figure S5: *Linear fit of the* $1/T$ *vs.* L *plot for blue zein particle dispersions, path-lengths measured were ranging from 0.5 to 5.0 mm and wavelengths between 750 and 875 nm (a range in which there is no absorption).*

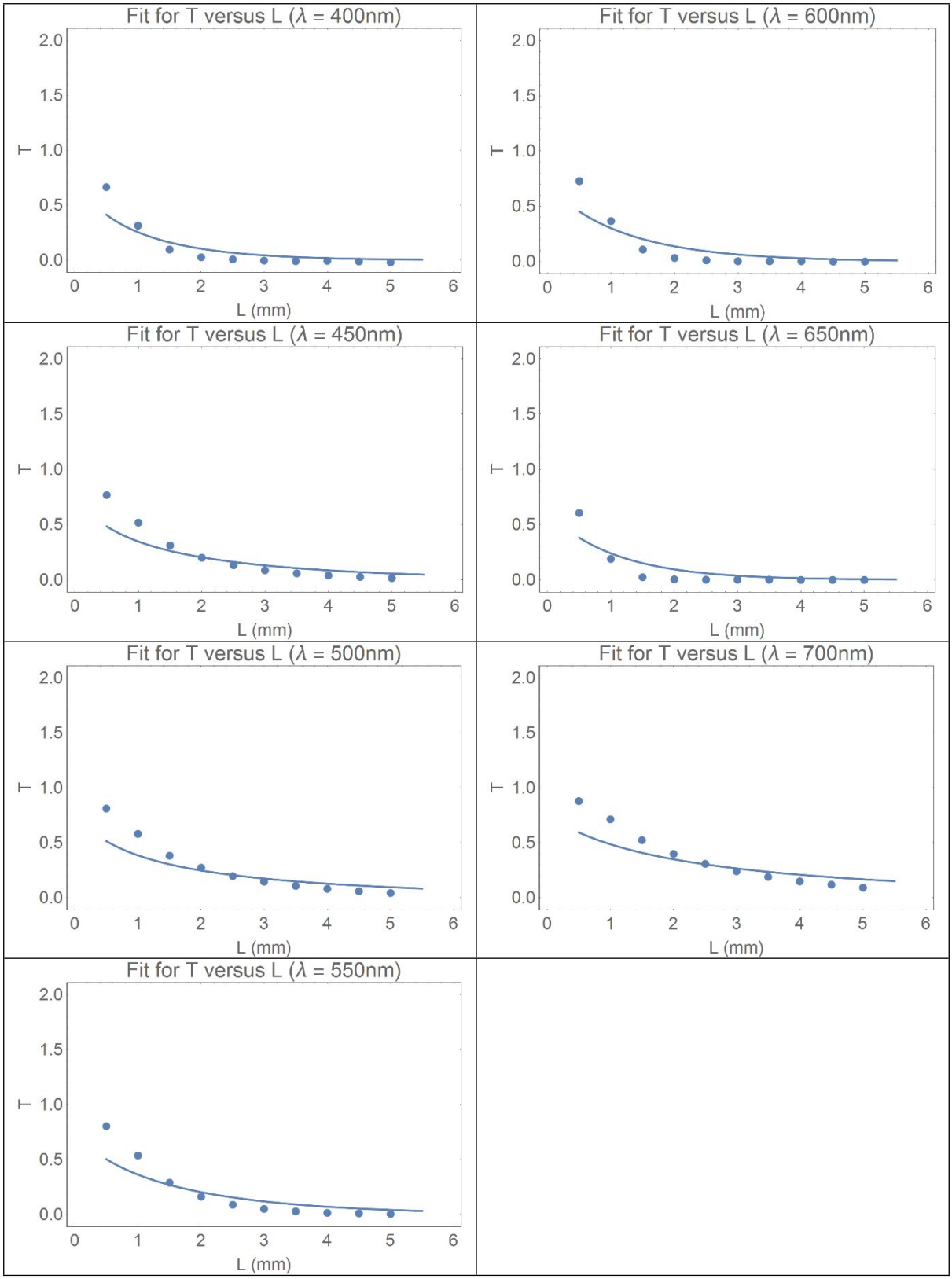

Figure S6: *Fit of the T vs.* L *plot for blue zein particle dispersions using Equations 5 and 6, path-lengths measured were ranging from 0.5 to 5.0 mm and wavelengths between 400 and 700 nm (a range in which there is absorption).*

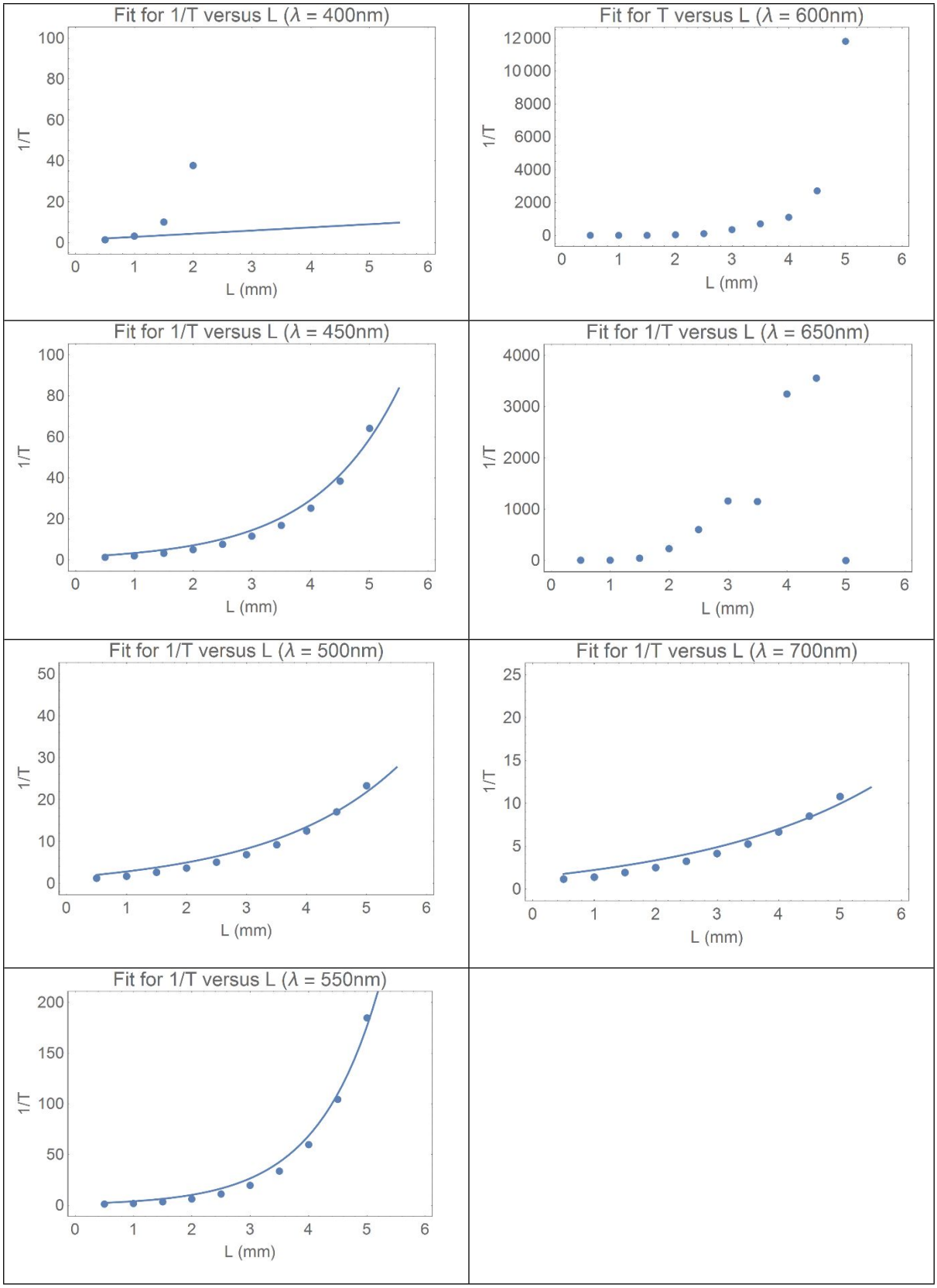

Figure S7: *Fit of the 1/T vs.* L *plot for blue zein particle dispersions using Equations 5 and 6, path-lengths measured were ranging from 0.5 to 5.0 mm and wavelengths between 400 and 700 nm (a range in which there is absorption). A fit could not be obtained for below 420 nm due to noise and between 570 and 680 nm due to strong absorption of the sample for these wavelengths.*

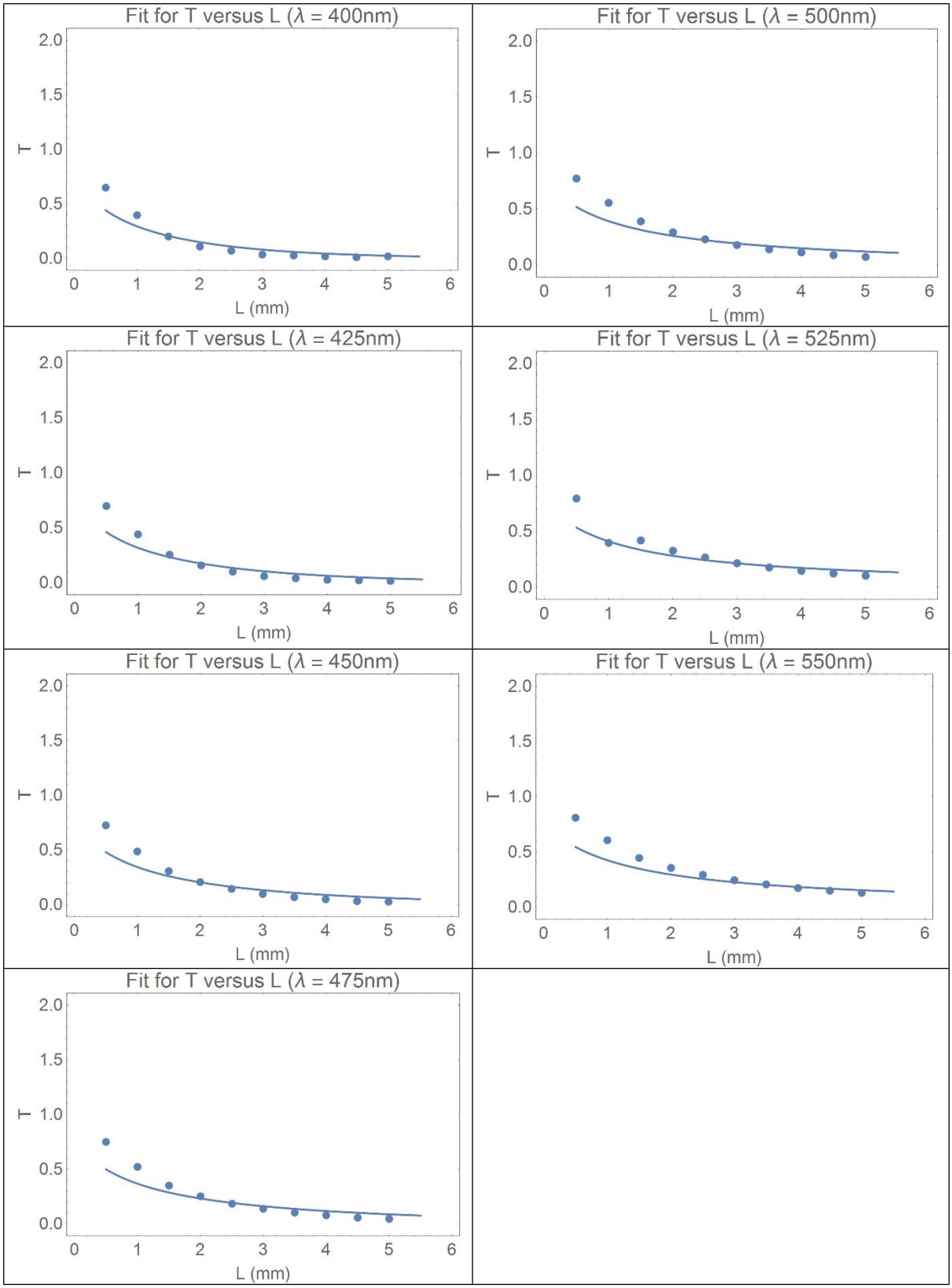

Figure S8: *Fit of the T vs.* L *plot for white zein particle dispersions using Equations 5 and 6, path-lengths measured were ranging from 0.5 to 5.0 mm and wavelengths between 400 and 550 nm (a range in which there is absorption).*

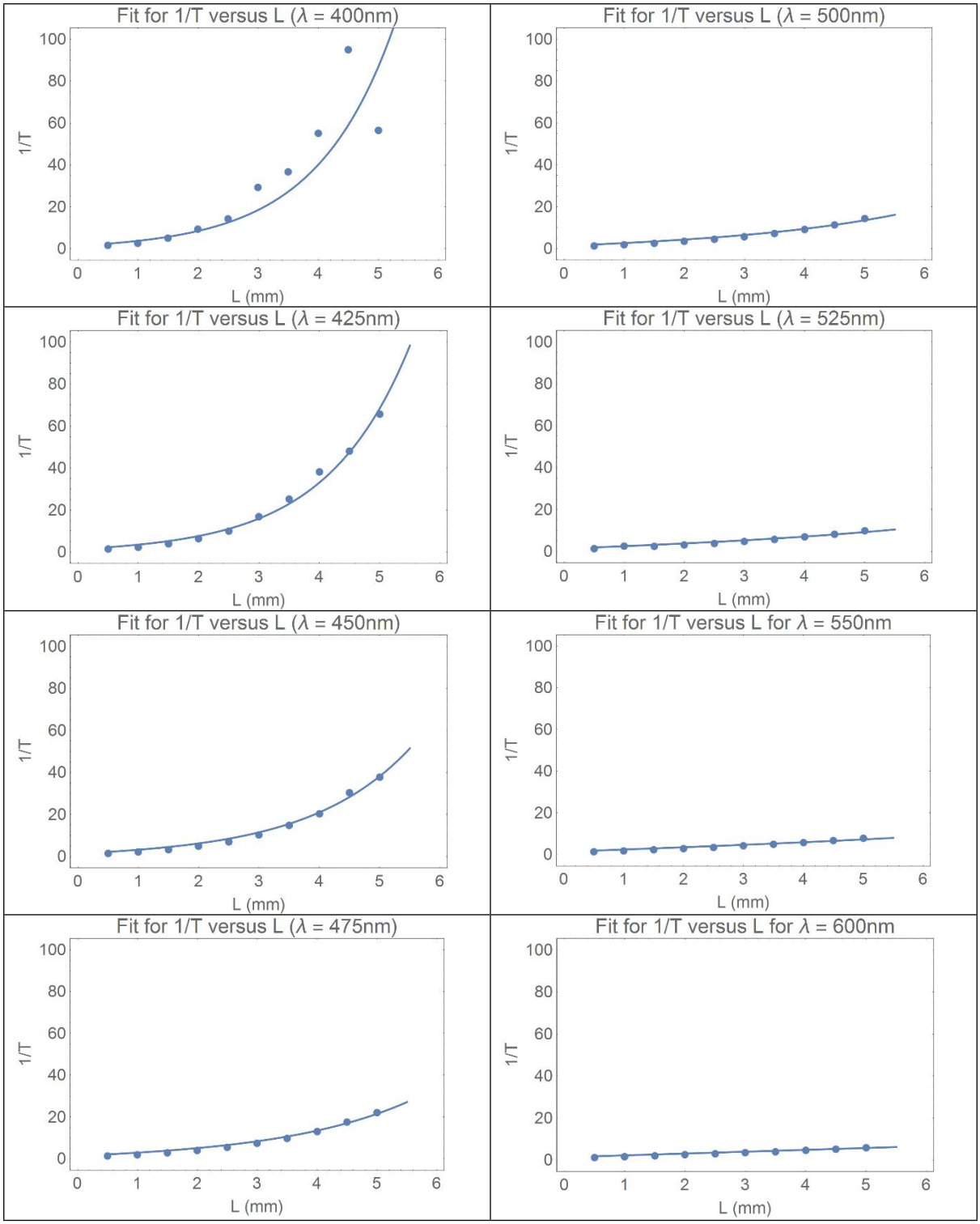

Figure S9: *Fit of the T vs.* L *plot for white zein particle dispersions using Equations 5 and 6, path-lengths measured were ranging from 0.5 to 5.0 mm and wavelengths between 400 and 550 nm (a range in which there is absorption).*