Supplementary data

Fresh $TPPS_4$ and $TPPS_4$-BSA solutions (2 μM) were prepared using the same procedure as described in the manuscript (Materials and Methods section). Between the measurements, the sealed samples were kept in the dark at 23°C. Three $TPPS_4$:BSA molar ratios (1:0.01; 1:1, 1:10) corresponding to the three stages of J-aggregates formation, which were specified and discussed in the manuscript (Figs. 6, 7), were chosen for this experiment.

Changes in absorption spectra of $TPPS_4$ and $TPPS_4$-BSA solutions occurring at 300 min after preparation can be seen in Fig. 1 (see below) in comparison with the spectra detected at 10 min (presented in the manuscript). All absorption spectra measured after 10, 120 and 300 minutes for pure $TPPS_4$ solution and each of $TPPS_4$-BSA mixed solutions are shown separately in Fig. 2.

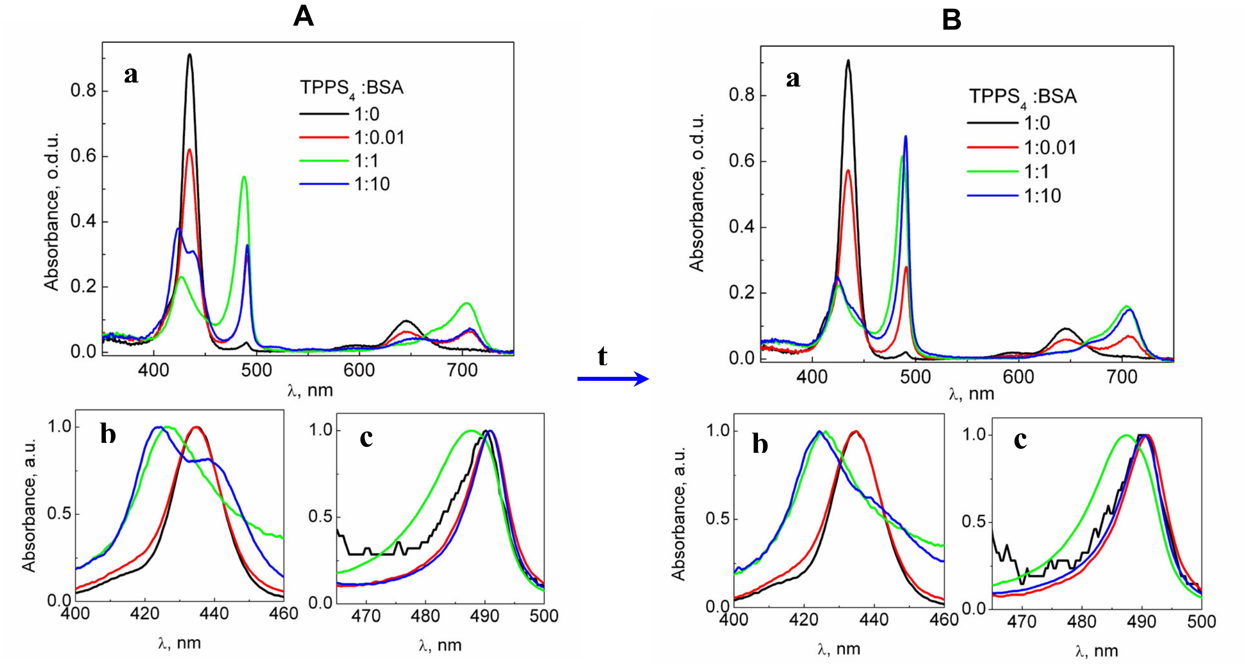

Fig. 1. Absorption spectra of $TPPS_4$ (2μM) and $TPPS_4$-BSA solutions measured after 10 (A) and 300 (B) minutes: (a)- original, (b, c)- normalized at the maxima of the Soret and J-band, respectively.

During five hours, only minor absorption changes were observed in the spectra of the pure $TPPS_4$ solution (Fig. 2A) and in the presence of low and intermediate BSA concentrations (Fig. 2 B,C). Consequently, the parameters of an excitonic band of J-aggregates given in the manuscript Fig. 6 for stages I and II change in time only insignificantly (Fig. 1A(c), 1B(c)). However, in the presence of high BSA concentration (stage III), slow formation of J-aggregates from two monomeric $TPPS_4$ species being initially bound to protein molecules (as reflected by decreasing absorption bands at 423 nm and 440 nm) still took place even at five hours after preparation (Fig. 2D). Although the intensity of the J-aggregates' absorption band increased in time, its bandwidth and spectral position (at 490 nm) remained almost unchanged (Fig. 1A(c), 1B(c)). Thus, the presence of high concentration of BSA does not destroy the J-aggregates in time, the spectral properties of which also differ from those (of the J-aggregate absorption band) observed at the intermediate BSA concentration.

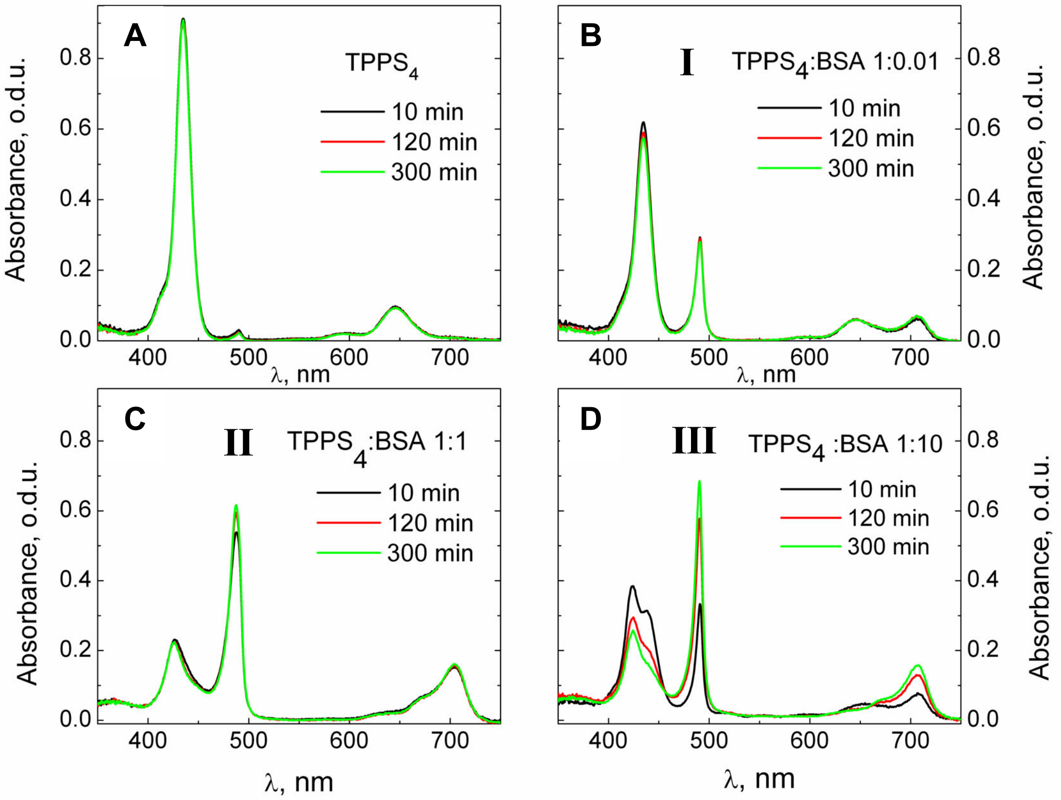

Fig. 2. Absorption spectra of $TPPS_4$ (A) and $TPPS_4$-BSA (B-1:0.01; C-1:1; D-1:10) solutions measured after 10, 120 and 300 minutes. Roman numerals indicate different J-aggregates formation stages at corresponding representative $TPPS_4$-BSA molar ratios.

In conclusion, the presence of different BSA amounts determines the specificity of interaction pattern between $TPPS_4$ and BSA in acid medium; consequently, the predominant type of J-aggregates in each stage could not be converted into another type by equilibrating the system.