Investigation of the kinetics of the redox changes of P_{700} in cyanobacterial photosystem I under single-flash excitation and continuous illumination in the presence of ascorbate

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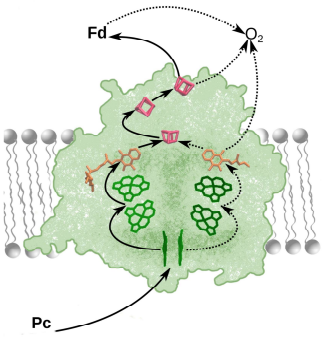
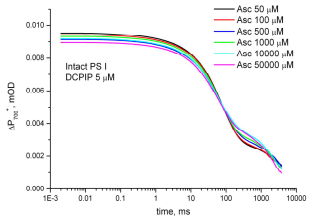
During the past decade the electron transfer processes in photosystem I (PS I) from *Synechocystis sp.* PCC 6803 were mainly investigated under single-flash excitation, however the mechanisms of the electron transfer in PS I under continuous illumination have not been investigated so intensively. Here we compare the kinetics of the redox-state changes of the primary electron donor in PS I P_{700} under single-flash and under continuous illumination.

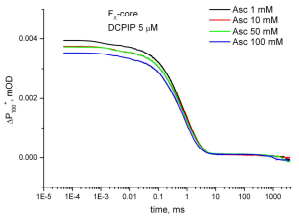


The question is: how does PS I work under the steady-state conditions?

The P_{700} redox-state changes were observed under single-flash laser excitation by measuring transient absorbtion chanches in submillisecond time range at 820 nm or under continuous white-light illumination using X-band transient EPR. Intact or F_A/F_B-depleted (F_X-core) PS I complexes were purified from the cyanobacteria *Synechocystis sp.* PCC 6803. The kinetics were registered in the presence of the increasing concentration of the redox-meditor sodium ascorbate (Asc).

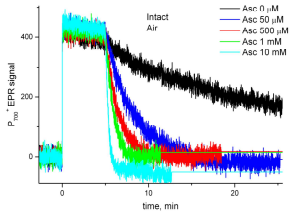
Single-flash excitation

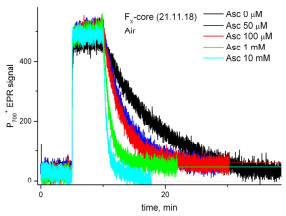




The amplitude of the slow kinetic phase, corresponding to the P_{700}^+ reduction by the external electron donor, demonstrates dependence on the Asc concentration. The kinetic of P_{700}^+ reduction in F_X-core complexes consists of the one dominant component, which amplitude does not depend on the concentration of Asc.

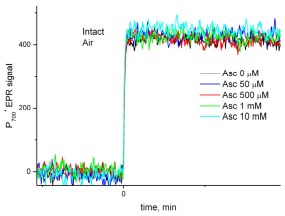
Continuous illumination: P_{700}^+ dark reduction

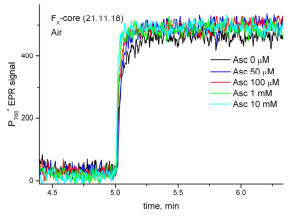




Under continuous illumination conditions the rate of the P_{700}^+ dark reduction, which was registered after the illumination, strongly depends on the Asc concentration in both types of complexes. However, in the absence of Asc the kinetic of the P_{700}^+ reduction in the intact complexes was much slower than in the F_X-core complexes.

Continuous illumination: P_{700} light-induced oxidation





The kinetic of the P_{700} oxidation also depends on the Asc concentration in F_X-core complexes, while in the case of intact complexes the rate of the P_{700} oxidation does not show visible dependence. That could be because the oxidation rate in the intact complexes is faster than the setup time resolution.

These results clearly show that Asc efficiently accepts electrons from intact PS I not only under continuous illumination, which has been shown before (Trubitsin et al., 2014), but also under flash excitation. In the case of the F_X-core complexes Asc is unable to compete for the electrons with the back reaction, that is why no concentration dependence was observed under flash-excitation conditions. At the same time, in F_X-core complexes the rate of P_{700} oxidation increase upon addition of Asc under continuous illumination, which indicates that under these conditions Asc accepts electrons from F_X-core complexes. That may be due to the significant deceleration of the backward electron transfer reaction in comparison with the single flash excitation.