

Biocompatibility of non-aqueous solvents with *Rhodobacter sphaeroides* chromatophores

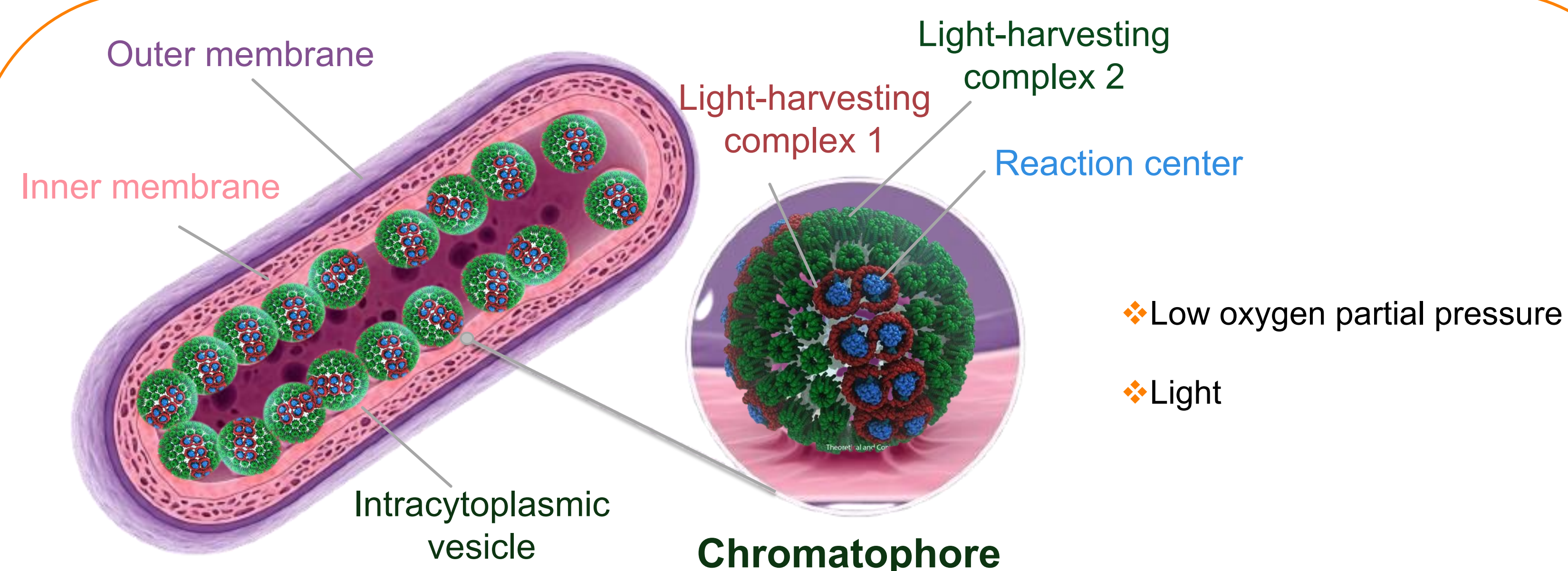
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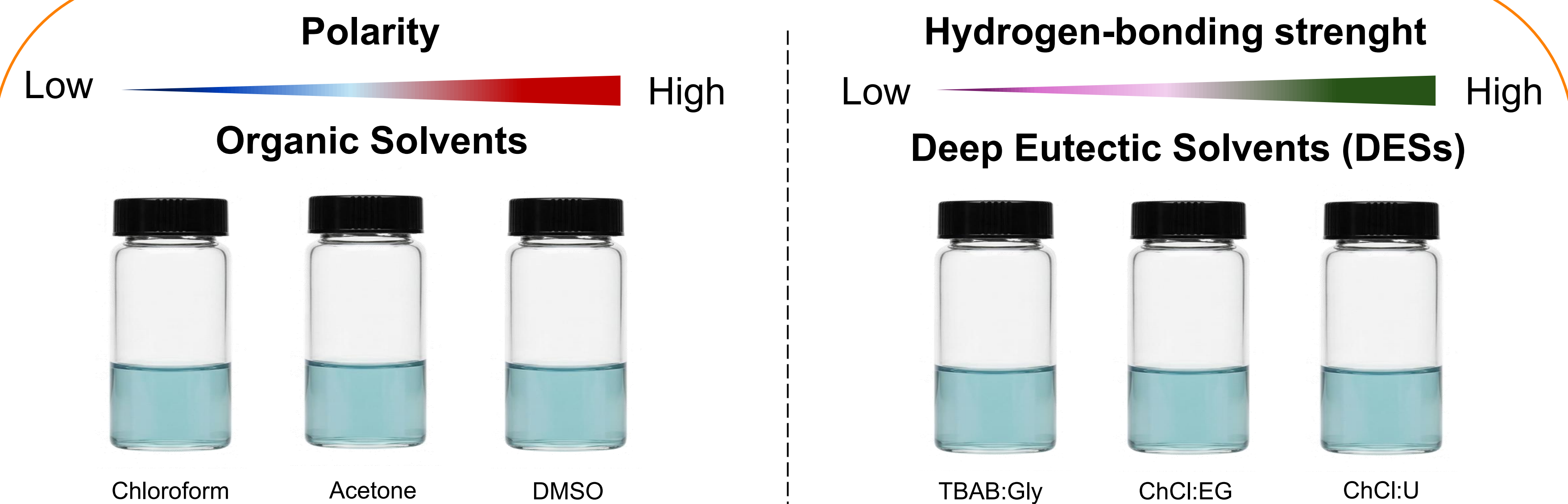
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1. Introduction

Solar energy conversion remains a central challenge in sustainable research. The aim of this work is to develop a bio-inspired sunlight-pumped laser based on photosynthetic complexes, creating a biohybrid system capable of converting diffuse solar radiation into a coherent laser emission.



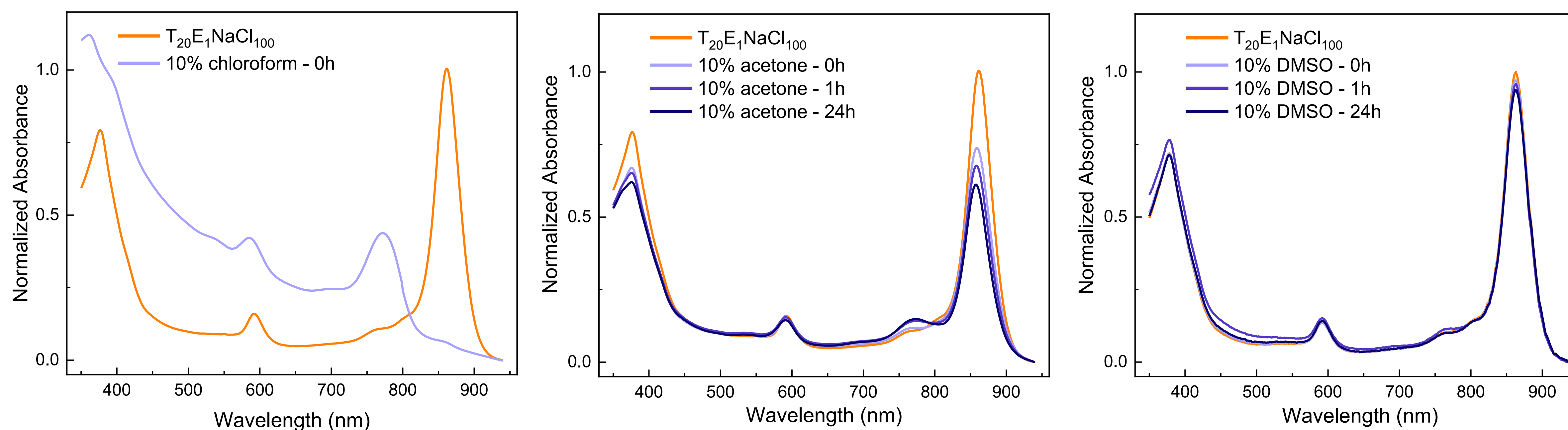
The biological system under investigation is *Rhodospirillum rubrum*, a purple non-sulfur bacterium and model organism for anoxygenic photosynthesis. Chromatophores contain the reaction center (RC) and the light-harvesting antenna complexes LH1 and LH2, responsible for efficient sunlight absorption and highly directed energy transfer with a quantum efficiency approaching unity, making them attractive candidates for next-generation biohybrid photonic and optoelectronic devices.



Breaking the solvent barrier expands photosynthetic systems beyond biological constraints. We investigate how polarity of organic solvents—**chloroform**, **acetone**, and dimethyl sulfoxide (**DMSO**) and hydrogen-bonding effects of deep eutectic solvents (DESs), affect chromatophores stability. Specifically, tetrabutylammonium bromide:glycerol (**TBAB:Gly**) 1:3 (molar ratio), choline chloride:ethylene glycol (**ChCl:EG**) 1:3 (molar ratio), and choline chloride:urea (**ChCl:U**) 1:2 (molar ratio) were studied.

2. Results and discussion

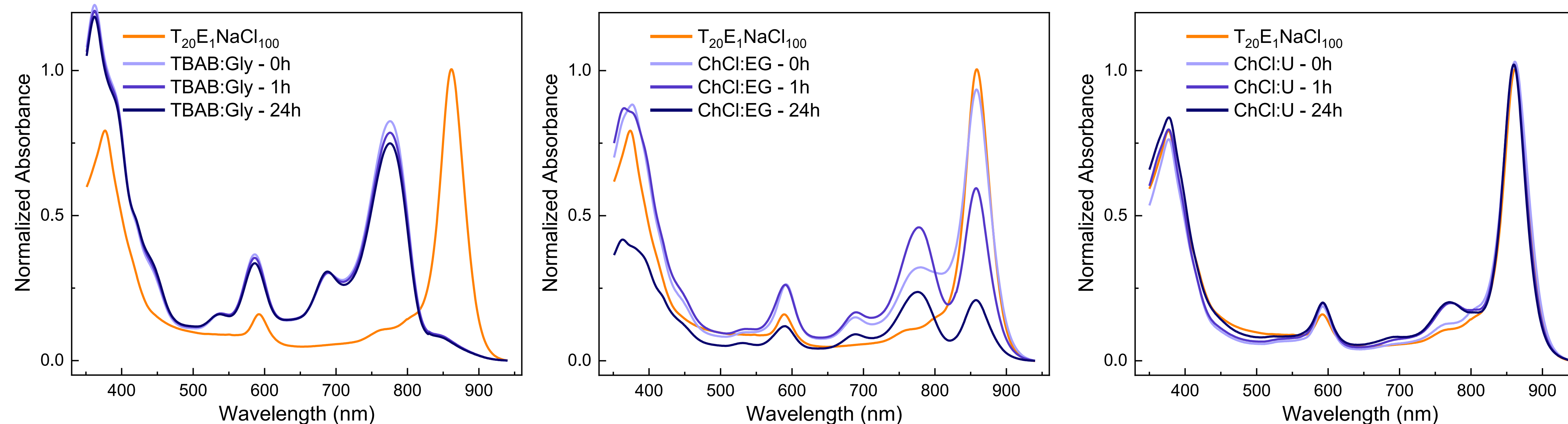
Organic solvents



- ❖ **Chloroform**: immediate and severe destabilization after addition, sharp decrease and blue-shift of the bacteriochlorophylls
- ❖ **Acetone**: progressive decreasing intensity at 860 nm over 24h, partial bacteriopheophytins extraction (760 nm)
- ❖ **DMSO**: minor spectral changes, pigment-protein complexes integrity, no structural damaged

$T_{20}E_1NaCl_{100}$: chromatophores buffer solution used as control

Deep Eutectic Solvents



- ❖ **TBAB:Gly**: rapid and pronounced disassembly of chromatophores, loss of bacteriochlorophyll absorption peak
- ❖ **ChCl:EG**: marked decrease in absorbance at 860 nm over 24h, enhancement of the bacteriopheophytin band at 760 nm
- ❖ **ChCl:U**: minor spectral changes at 860 nm, chromatophore organization largely preserved

3. Conclusions

UV–Vis–NIR spectroscopy indicates that chromatophore stability in non-aqueous media is governed by both solvent polarity and hydrogen-bonding interactions. DMSO (10% v/v) emerged as the most compatible organic solvent, while among DESs, ChCl:U most effectively preserved the structural and spectroscopic integrity of the complexes. These findings highlight the critical role of solvent environment in maintaining functional photosynthetic architectures, providing key insights for the development of biohybrid platforms aimed at converting diffuse solar energy into coherent laser beam.

