

Taking a Sneak Peek at Nature's Chemistry Notes on Photosynthesis



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A key reaction sustaining most life is photosynthesis, the conversion of carbon dioxide (CO_2) and water (H_2O) to glucose (sugar) and oxygen (O_2). This reaction is commonplace in plants and several other organisms and generates energy resources that life thrives on. Despite the abundance of this chemistry, nature has settled on one highly conserved structure to enable photosynthesis: *Photosystem II* (PSII). This suggests the chemical bond rearrangements involved in the process require specific and non-trivial conditions. How PSII conducts this reaction remains unresolved, with the electron transfer (ET) properties of chlorophyll-*a* pigments in the reaction centre (a pigment called P680) playing a key role. By understanding what the conditions PSII uses, chemists could synthesise PSII analogues that could be used for carbon capture, helping stabilise the carbon cycle from the use of fossil fuels. Water splitting could also become accessible as a green energy alternative. Subsequent novel chemistry might enable chemists to tackle other challenges like energy-intensive fertiliser synthesis.¹

P680 comprises of four chlorophyll-*a* pigments whose ET properties are tuned through suspected electrostatic interactions (Fig. 1a).² In this work, simple analogue molecules (mimics) of chlorophyll were synthesised and analytically probed to recreate a similar tuning response (Fig. 1b). The mimics can bind to metal cations, enabling positive charges from metal cations to come into close proximity of the chlorophyll magnesium centre, simulating the peripheral charge density found in P680. Binding different metals allows for investigating the effect of ion charge and radius on tuning the ET chemistry of the mimic. Compared to previous work on chlorophyll mimics, the tuning of the ET by proximity cations was increased two-fold, employing a lower peripheral charge but a small charge-to-mimic distance.³ These findings showcase how peripheral charge can play a significant role in tuning chlorophyll ET.

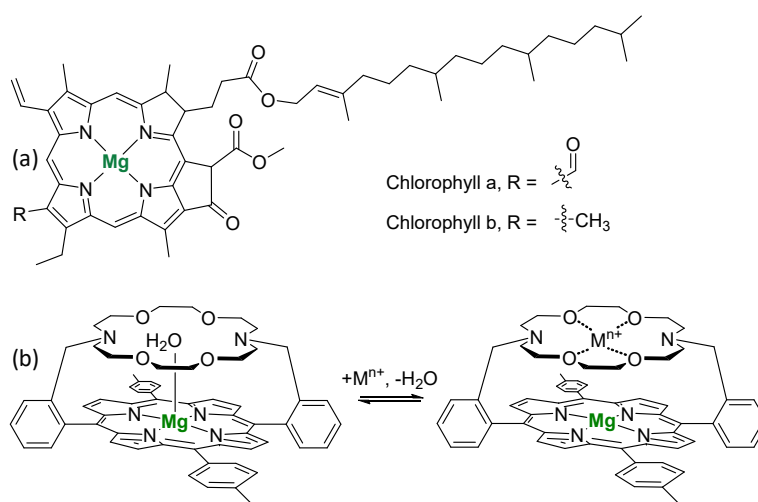


Figure 1: (a) Structure of chlorophyll. (b) Chlorophyll mimic relevant to this study.

References

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