

# Artificial quantasomes: bioinspired assemblies for clean fuel production

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Photosynthesis, the fundamental process through which plants, algae, and some bacteria convert sunlight into chemical energy, demonstrates remarkable efficiency, potentially driven by quantum mechanical phenomena such as coherence, entanglement, and tunneling. Recent studies have shown that quantum coherence in light-harvesting complexes enables excitons to traverse multiple pathways simultaneously, optimizing energy transfer efficiency even at physiological temperatures.

Among the most innovative strategies in the energy transition, photo-electrocatalytic water splitting for the production of green hydrogen emerges as a promising approach. This process, driven by sunlight, provides an ideal energy carrier obtained from renewable and circular resources. In contrast to current methods that rely on fossil fuels, such as natural gas reforming or pyrolysis, which generate significant CO<sub>2</sub> emissions, hydrogen production through water splitting offers a sustainable and clean alternative. By mimicking the perfect mechanisms of photosynthesis, artificial systems can produce hydrogen as a solar fuel, powering the H<sub>2</sub>O/O<sub>2</sub> cycle and supporting sustainable development.

Inspired by natural photosynthesis, artificial quantasomes represent a viable solution for photocatalytic water splitting. These systems take advantage of ultrafast symmetry breaking, driving biomimetic water splitting for hydrogen production. Specifically, a new catalytic system based on perylene bis-imides and polyoxometalates, arranged in a hierarchical assembly, demonstrates significant potential for enhancing the efficiency of artificial photosynthesis. This innovative combination offers new opportunities for solar-driven fuel production, contributing to a future of quantum-enhanced solar technologies and sustainable energy solutions.

## References

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