CAMBRIDGE ZERO

Light Harvesting
Special Interest Group

Solar-powered Biology and the Production of Sustainable Chemicals

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Panel

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Discussion Points

- Biohybrid systems sit between artificial and natural photosynthesis, with the aim of offering the best of both worlds. This can constitute a wide variety of different systems, from single isolated enzymes to colonies of multiple species of whole cells. These systems aim to use solar light to drive chemistry, however how this is integrated spans a great variety of approaches and degrees of integration, from synthetic light absorbers and electrolysers to photosynthetic organisms integrated with materials.
- Photovoltaics (PV) are well established and very efficient at converting photons to electrons, and biology is very efficient at converting solar light and simple building blocks such as CO_2 into biomass, neither of these immediately meet the needs of the chemicals industry.
- PV alone currently cannot address the demands of the chemicals industry as not all processes are suitable for direct electrification and many require chemicals.
- Biomass requires heavy processing to make useful chemicals, significantly decreasing it's efficiency.
- Biohybrids allow for the targeted production of fuels and chemicals of interest, using the integration of synthetic materials and light harvesters to explore niches that biology or artificial photosynthesis/PV electrolysis alone cannot target.
- There are some limited examples of where targeted biohybrid systems are already efficiently producing C_2+ products such as acetate, butanol and hexanol.
- The complexity of biohybrid systems means their development and optimisation is hard, as many factors have to be developed together. Tools that have been developed for PV such as ultrafast spectroscopy can be adapted to start to unravel this complexity.
- Academia and industry have different focuses, industry favouring more established technology such as PV-electrolysis and dark fermentation, whereas academia plays a role of attempting to upset the status quo and has a greater interest in highly integrated systems that offer theoretically higher performance, but are yet to deliver.

Challenges

- Efficient integration of biological systems with synthetic materials.
- Redirecting biological systems to make fuels and chemicals of interest to society.
- Finding a market niche where biohybrid systems can compete against well established technologies.
- Developing tools that allow the understanding and optimisation of complex biological systems to improve their efficiency.

Opportunities

- The targeting of more complex chemicals where biohybrid devices have greater potential to be economically viable
- The integration of biological systems where they can be complementary to existing established technologies- for instance exploiting more of the solar spectrum.
- The development and utilisation of new tools and techniques that can allow the complexity of biological systems to be unravelled and optimised.

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