Photosynthesis of hydrogen peroxide by a scaled-up reactor

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Particulate photocatalysis (PC) has been widely investigated for environmentally friendly production of hydrogen peroxide (H_2O_2).[1] Yet, most existing PC systems for H_2O_2 generation are based on powder suspensions, which are not applicable to large-scale H_2O_2 synthesis.[2, 3] Consequently, the development of a scalable PC system has remained a formidable obstacle, impeding the practical implementation of H_2O_2 photosynthesis.

In this study, we report a flexible photocatalyst sheet based on visible-light-responsive $BiVO_4$ ($\lambda < 520$ nm) for the scalable production of H_2O_2 from water and oxygen. We successfully upscaled the production by deploying $BiVO_4$ photocatalyst sheets in a 1-m^2-flow-by reactor in a 4×4-panels array (Figure 1). The H_2O_2 synthesis on this panel reactor exhibited durability, with no loss of activity over one -month field test.

To illustrate the practical utility of the photosynthesized H_2O_2, we applied it to disinfection, achieving over 99.9% inactivation of a coronavirus surrogate within 60 minutes. Furthermore, a techno-economic analysis demonstrates the economic viability of H_2O_2 photosynthesis using the panel reactor. Our findings underscore the scalability and economic feasibility of photocatalytic H_2O_2 generation, enhancing its readiness for practical applications.

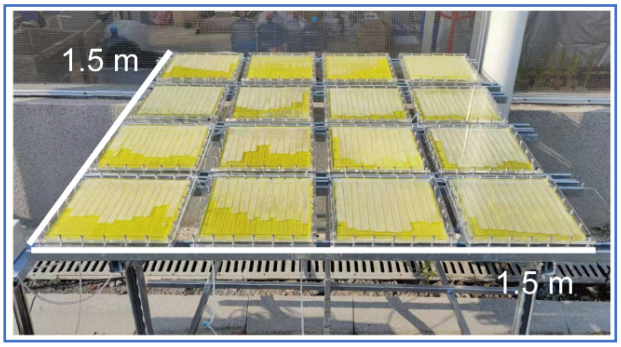

Figure 1 Digital photo of the 1-m^2 arrayed panel flow reactor.

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