Journal of Applied Mechanical Engineering
Chuan and Hoque, J Appl Mech Eng 2014, 3:3
DOI: 10.4172/2168-9873.1000e131

Editorial Open Access

Engineering and Biomimetics: Harnessing Light Energy for Sustainability

Chuan YL[1] and Enamul Hoque Md[2]*

[1]*Department of Mechanical Engineering, Taylor's University Lakeside Campus, Malaysia*
[2]*Department of Mechanical, Materials and Manufacturing Engineering, University of Nottingham Malaysia Campus, Malaysia*

In recent years, researchers and engineers have recognized the necessity of harnessing alternative renewable sources of energy that focuses on sustainability and efficiency before the existing non-renewable sources deplete. Biomimetic that imitates nature's most successful developments to solve complex human challenges [1] could be utilized to harness alternative renewable energy in order to accustom to the ever increasing demand of the exponential growth of population. For example, mimicking the photosynthesis process performed by green plants solar energy can be harnessed and synthesized to produce fuels for transportation, industry and electricity generation. Scientists have recently attempted to develop artificial photosynthesis process, where sunlight is harvested and used to chemically convert H_2O and CO_2 into two solar fuels namely, hydrogen fuel and carbon-based fuel such as methane, carbon monoxide and methanol [2]. This process is termed as CO_2 reduction and is executed by using solar-derived hydrogen as a reducing agent [3]. The produced solar fuels can then be utilized in transportation, electricity generation, and production of fertilizers, plastics etc.

It is proven that the artificial photosynthesis is 76% more efficient as compared to natural photosynthesis [4]. The lack of efficiency in natural photosynthesis might be due to the irregularities in nature whereby every plant is different from one another. The inefficiency of natural photosynthesis is also caused by the catalysts being ineffective during the photolysis of water. Referring to the absorption of light, photosynthetic plants are only able to absorb 50% of incident solar radiation compared to the photochemical cells found in the artificial leaf where, the amount of light absorbed can be manipulated by the material used [5]. Despite of higher efficiency, the biomimetic photosynthesis (in turn, artificial leaf) is yet proven to be unsustainable as it is only a reductive mimicry of the photolysis process of H_2O. The artificial leaf is made to be cost efficient sacrificing its energy efficiency. The lifespan of the artificial leaf is still uncertain but research shows that the leaf can operate for 45 hours continuously without a single drop in functional activity [6]. For the artificial leaf to be sustainable and efficient, it must be able to mimic the light-independent reaction (i.e. fixation of carbon). In an artificial leaf, the catalysts present are not separated as it is an integrated homogenous system. Thus, hydrogen and oxygen will always be produced in the same location. The efficiency of the leaf is compromised as the combination of both gases can lead to explosive circumstances.

There are many factors which limit the functionality of the artificial leaf. The materials used in the artificial photosynthesis frequently corrode when come in contact with water making them less stable over long periods of time. In accordance to that, hydrogen catalysts used in the artificial leaf are also very sensitive to oxygen with the possibility of being inactivated or degraded in its presence. From a costing point of view, the price to research and develop an artificial leaf is still commercially costly as compared to fossil fuels. Looking further into the working principle of the artificial leaf, the natural water dissociation mechanism is difficult to be mimicked by man-made materials causing the limitation. Overall, the concept of biomimetic photosynthesis (i.e. artificial leaf) is rather innovative, and if it is accustomed to commercial use shall bring an enormous step ahead in terms of green technology.

References

1. Volstad N, Boks C (2012) On the use of Biomimicry as a Useful Tool for the Industrial Designer, Sustainable Development 20: 189-199.
2. Hammarstrom L, Hammes-Schiffer S (2009) Artificial photosynthesis and solar fuels, Accounts of chemical research 42: 1859-1860.
3. Woolerton TW, Sheard S, Pierce E, Ragsdale SW, Armstrong FA (2011) CO_2 Photoreduction at enzyme-modified metal oxide nanoparticles, Energy and Environmental Science 4: 2393-2399.
4. Chaintreuil C, Giraud E, Prin Y, Lorquin J, Bâ A, et al. (2000) Photosynthetic Bradyrhizobia Are Natural Endophytes of the African Wild Rice Oryza breviligulata, Appl Environ Microbiol 66: 5437-5447.
5. Gray HB (2008) Engineering and Science 2: 26-31.
6. Blankenship RE, David MT, James B, Gary WB, Graham F, et al. (2011) Comparing Photosynthetic and Photovoltaic Efficiencies and Recognizing the Potential for Improvement, Science 332: 805-809.

***Corresponding author:** Md Enamul Hoque, Department of Mechanical Engineering, Materials and Manufacturing Engineering, University of Nottingham, Malaysia, Tel: +6(03)89248367; E-mail: enamul.hoque@nottingham.edu.my

Received June 03, 2014; **Accepted** June 04, 2014; **Published** June 10, 2014

Citation: Chuan YL, Hoque ME (2014) Engineering and Biomimetics: Harnessing Light Energy for Sustainability. J Appl Mech Eng 3: e131. doi:10.4172/2168-9873.1000e131