Green technologies: innovations, challenges, and prospects

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Green technologies have been receiving much attention globally over the past two decades, driven mainly by ever-increasing demands for more efficient and sustainable uses of resources. These demands call for the necessity to develop technological innovations and responsible practices that are more environmentally benign, to address challenges arising from the over-exploitation of resources and environment. A total of eleven papers were accepted for publication after a stringent peer review process. These papers are contributed by outstanding researchers from the Asian region, including India, Japan, Malaysia, and Taiwan. This special issue serves to offer insights into technological advancements and prospects, which are centred on three key topics: (1) sustainable energy management, (2) chemical and biological processing, and (3) advanced materials for nanocomposites and catalysis.

Statistics from the World Bank have shown that the current world consumption of fossil fuels amount to 80% of the total energy consumption. This figure is even higher in the Asia Pacific region, recorded at an alarming 89%. This enormous amount of fossil fuel usage has resulted in massive greenhouse gas emission that causes global warming and is expected to increase drastically during the years 2050–2100. Henceforth, this prompted the European Union to promote renewable energy utilisation to lessen the dependency on non-renewable energy imports and increase supply security. This has given rise to increased attention to biomass-based renewable energy. On the other hand, an increase in CO₂ in the atmosphere due to globalisation and industrialisation has

led to significant alteration in the global carbon cycle and global warming issues. Therefore, research on clean technologies towards atmospheric CO₂ reduction through carbon sequestration is rapidly gaining interest from researchers worldwide.

Worldwide attention has been dedicated for research and development in biorefinery in response to environmental issues, such as CO₂ emissions and demand for integrated production of biopolymers, biochemical, and biofuels as alternatives to fossil fuels through the conversion of biomass. Biochar production from microalgae through pyrolysis is attractive due to its potential for use as a viable strategy to achieve negative carbon emission technology. Meanwhile, lignocellulosic biomass has been widely used to replace fossil-based resources due to its abundance. For instance, empty fruit bunches (EFB) of the oil palm industry is one of the most abundant lignocellulosic biomass, accounting for 20% of fresh fruit weight at an annual production rate of about 15.8 million tonnes. In terms of biorefinery, conversion of lignocellulosics via chemical and biological techniques has the capability to supply future society with environmental friendly energy and chemicals, while optimising biomass utilisation, economics, and sustainability.

In order to reduce the harmful effects on environment (e.g. greenhouse gases and other pollutants), alternative methods for the generation of hydrogen as energy source are being actively pursued. This is aided by the development of novel nanocomposite materials that act as catalysts. In addition, research and development into efficient palm oil mill effluent (POME) wastewater treatment has been intensively carried out to achieve a sustainable development of oil palm industry besides reduced harmful wastes. This is crucial as POME is potentially harmful to human health and detrimental to environment. There are also researchers working on chemical product design (CPD) as an established approach to convert the consumers' needs into marketable products. To conclude, research on multidisciplinary areas is reported here, and we strongly believe these are beneficial in achieving a better environment.

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