

## **A review on advances in green treatment of glycerol waste with a focus on electro-oxidation pathway**

*Muhammad Sheraz Ahmad<sup>a</sup>, Mohd Hasbi Ab Rahim<sup>b</sup>, Tariq Mohammed Alqahtani<sup>c</sup>, Rabah Mouras<sup>c</sup>, Thongthai Witoon<sup>d</sup>, Jun-Wei Lim<sup>e</sup>, Chin Kui Cheng<sup>a</sup>, Md.Maksudur Rahman Khan<sup>b</sup>*

<sup>a</sup> Department of Chemical Engineering, College of Engineering, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300, Gambang, Pahang, Malaysia

<sup>b</sup> Faculty of Industrial Sciences and Technology, Universiti Malaysia Pahang, Malaysia

<sup>c</sup> College of Applied Medical Sciences, Almujaah University, Saudi Arabia

<sup>d</sup> Department of Chemical Engineering, Kasetsart University, Bangkok, Thailand

<sup>e</sup> School of Chemical Sciences, Universiti Teknologi PETRONAS, Tronoh, Perak, Malaysia

### **ABSTRACT**

Over the past decades, research efforts are being devoted into utilizing the biomass waste as a major source of green energy to maintain the economic, environmental, and social sustainability. Specifically, there is an emerging consensus on the significance of glycerol (an underutilised waste from biodiesel industry) as a cheap, non-toxic, and renewable source for valuable chemicals synthesis. There are numerous methods enacted to convert this glycerol waste to tartronic acid, mesoxalic acid, glyceraldehyde, dihydroxyacetone, oxalic acid and so on. Among these, the green electro-oxidation technique is one of the techniques that possesses potential for industrial application due to advantages such as non-toxicity process, fast response, and lower energy consumption. The current review covers the general understanding on commonly used techniques for alcohol (C1 & C2) conversion, with a specific insight on glycerol (C3) electro-oxidation (GOR). Since catalysts are the backbone of chemical reaction, they are responsible for the overall economy prospect of any processes. To this end, a comprehensive review on catalysts, which include noble metals, non-noble metals, and non-metals anchored over various supports are incorporated in this review. Moreover, a fundamental insight into the development of future electrocatalysts for glycerol oxidation along with products analysis is also presented.

### **KEYWORDS**

Glycerol; Electro-oxidation; Multi-walled carbon nanotubes; Noble metals; Non-noble metals

**ACKNOWLEDGEMENT**

The first author would like to record his appreciation to Universiti Malaysia Pahang for the Postgraduate Research Scheme (PGRS 180335).