Nanoengineering of Optocatalytic Microreactor with Immobilized Catalysts for Selective Oxidation of Aromatic Alcohols

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Lignin is a major by-product generated from paper and pulp industries. The development of a photocatalytic system for the valorization of lignin is a challenge because of the high variability in its composition[1]. There are many reports which proved that microreactor is a superior approach to carry out photocatalysis because of some properties like improved irradiation profile, sizeable surface-to-volume ratio, enhanced mass transfer characteristics, on-site/on-demand production, higher spatial illumination homogeneity, and better light penetration through the entire reactor depth compare to conventional batch[2]. The use of sonication for designing these reactors, especially deposition of catalyst inside a microreactor, is very new approach. Ultrasound based experiments have advantages such as no addition of chemicals, shorter reaction time as compared to other technologies, etc[3]. The generation of different substances which has high value in pharmaceuticals and chemical industries is possible by using these methods. Recently, the conversion of aromatic alcohol into its aldehyde has attracted considerable attention due to its fundamental interest and potential applications[4]. Alcohol oxidation to aldehyde is an important reaction, as the many aldehyde products find extensive application in the food, pharmaceutical, perfume, and agrochemical industries[5].

Photocatalysis based selective oxidation of benzyl alcohol has been carried out using commercially available and synthesized TiO_2 photocatalysts. However, heterogeneous photocatalysis in microreactor is still a novel research area, new methodologies for deposition of the photocatalysts inside the microchannels using ultrasound have to be determined[6]. The current work focusses on the selective photocatalytic oxidation of the lignin-based model compound in a polymer-based (PFA) microfluidic photoreactor. For this study, photocatalysts were taken and deposited internally on the walls of a PFA microtubes with the help of ultrasound. Evaluation of the photocatalytic activity of these microcapillaries carried out for selective conversion of aromatic alcohol to its aldehyde.

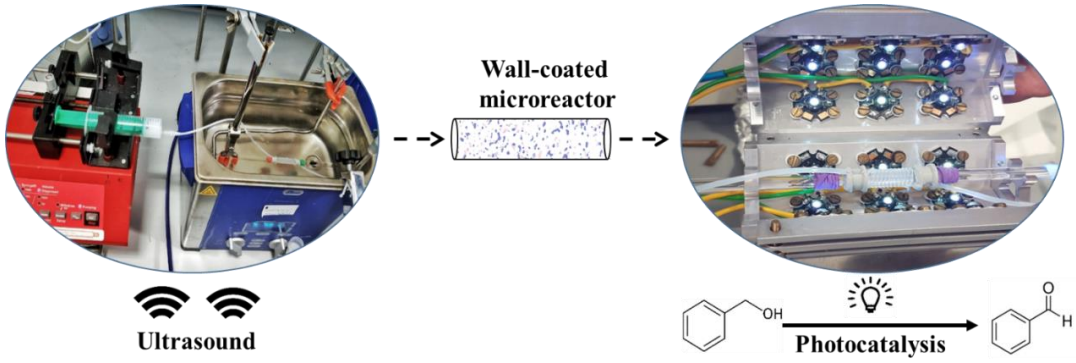

Figure 1. Selective oxidation of aromatic alcohol to aldehyde inside semiconductor coated PFA tube

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***References*:**
(1) Gnansounou, E; Pandey, A. *Life-cycle Assessment of Biorefineries.* **2017**, 1–39.
(2) Yao, X.; Zhang, Y.; Du, L.; Liu, J.; Yao, J. *Renew. Sustain. Energy Rev.* **2015**, *47*, 519–539.
(3) Adewuyi, Y. G. *Environ. Sci. Technol.* **2005**, *39* (10), 3409–3420.
(4) Zheng, C.; He, G.; Xiao, X.; Lu, M.; Zhong, H.; Zuo, X.; Nan, J. *Appl. Catal. B Environ.* **2017**, *205*, 201–210.
(5) Krings, U.; Berger, R. G. *Appl. Microbiol. Biotechnol.* **1998**, *49* (1), 1–8.
(6) Colmenares, J. C.; Varma, R. S.; Nair, V. *Chem. Soc. Rev.* **2017**, *46* (22), 6675–6686.