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www.elsevier.com/locate/memsci

PII: S0376-7388(16)31434-X
DOI: http://dx.doi.org/10.1016/j.memsci.2016.08.056
Reference: MEMSCI14706

To appear in: *Journal of Membrane Science*

Received date: 18 April 2016
Revised date: 24 August 2016
Accepted date: 26 August 2016

Cite this article as: Chao Ji, Jingwei Hou and Vicki Chen, Cross-linked carbon nanotubes based biocatalytic membranes for micro-pollutants degradation: Performance, stability, and regeneration, *Journal of Membrane Science* http://dx.doi.org/10.1016/j.memsci.2016.08.056

Cross-linked carbon nanotubes based biocatalytic membranes for micro-pollutants degradation: performance, stability, and regeneration

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ABSTRACT

The presence of the micro-pollutants in the aqueous environment has become a major environmental challenge. The enzymatic membrane reactor (EMR) provides a promising approach to tackle this problem through benign enzymatic biodegradation, and the fabrication of highly efficient enzymatic membrane is the key to this process. By using a facile carbon nanotube (CNTs) coating technique, we prepared a stable CNTs coating on a polymer membrane support, which was then applied for laccase immobilization via both physical adsorption and covalent bonding. The biocatalytic membrane possessed stability for long-term storage and under hydraulic shear force. Micro-pollutant degradation was carried out with a mixture of five representative compounds (bisphenol-A (BPA), carbamazepine (CBZ), diclofenac (DCF), clofibric acid (CA) and ibuprofen (IBF)). The EMR exhibited substantial improvement in micro-pollutant removals compared with the CNTs coated membrane having no enzyme. Furthermore, the effect of CNTs loading, operational flux on the EMR performance was examined, and the stability of the enzymatic membranes were studied. Active laccase coatings on CNTs based membrane could be renewed after simple cleaning and re-coating, offering new opportunities towards sustainable, long-term applications.

Abbreviations: