Proc. of the Intl. Conf. on Nanotechnology for Better Living, 2016
Editors K. K. Kar, A. Shah and R. Sharma
Vol. 3, No. 1, p. 251
doi:10.3850/978-981-09-7519-7nbl16-rps-251

Fabrication of three dimensional structures using microbes based printing

Sunita Mehta[1*], Saravanan Murugeson[2], Balaji Prakash[2] and Deepak[1]

[1]Department of Materials Science & Engineering and Samtel Center for Display Technologies, Indian Institute of Technology Kanpur, Kanpur-208016
[2]Department of Biological Sciences & Bioengineering, Indian Institute of Technology Kanpur, Kanpur- 208016
*Email: smehta@iitk.ac.in

The present work reports the use of a novel microbes based printing for fabrication of three dimensional structures. The natural ability of the microbes to grow into three dimensional colonies, when provided with sufficient nutrient media has been used as an asset here. The process involves the use of an intermediate porous membrane/paper as a substrate for these microbes (Figure 1).

For dispensing of the microbes on this substrate, printing techniques such as inkjet and screen printing have been employed. We have used yeast culture of unit optical density as an ink. The final resolution of the printed pattern depends upon its physical and rheological properties. Further, inkjet and screen printing, both the processes have their own essential requirements. Therefore, the ink has been examined for better printability by introducing varying concentrations of surfactants. The optimized ink is printed on the substrate and then allowed for incubation. After growth, these microbes result into three dimensional structures. In order to demonstrate the potential use of this process, we have selected two applications- 1) fabrication of microlenses for enhancement of light extraction efficiency of OLEDs, where microbes are dispensed through inkjet printing process and 2) fabrication of braille text patterns, where screen printing has been employed for introducing microbes. A maximum enhancement of 1.24X has been achieved from the microlenses thus fabricated. Moreover the braille text patterns thus generated meets the essential standards required for braille books.

References

1. D. Gupta, B. Prakash, S. Mehta and S. Murugeson, US Pat.,USWO2014/184687 A1. 2014, 2014.
2. S. Mehta, S. Murugeson, B. Prakash and Deepak, Sci. Rep., 2015, 5, 15416.

Figure 1: Photographic images for patterned growth of microbes on substrates. (a) untreated PVDF membrane displaying no growth (b) growth of E.coli on PVDF membrane treated with Triton X-100 (c) as grown yeast on surfactant treated PVDF (d) legible pattern of grown yeast on PVDF membrane with culture ink (inoculum + surfactant) dispensed using micro-pipette (e) negative image of the same pattern in which culture ink is spread thorough-out and growth is inhibited by antimicrobial agent dispensed in the BSBE pattern. (f) grown yeast pattern with significant height even after drying