World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:17, No:08, 2023

Microfluidic Construction of Responsive Photonic Microcapsules for Microsensors

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Abstract : As alternatives to electronic devices, optically active structures from responsive nanomaterials offer great opportunity buildup smart functional sensors. Hereby, we report on droplet microfluidics enabled construction and application of photonic microcapsules (PMCs) for colorimetric temperature microsensors, enabling miniaturization for injectable local micro-area sensing and integration for large-area sensing. Monodispersed PMCs are produced by in-situ photopolymerization of hydrogel shells of cholesteric liquid crystal (CLC)-in-water-in-oil double emulsion droplets prepared using microfluidic devices, with controllable physical structures and chemical compositions. Constructed PMCs exhibit thermal responsive structural color according to the selective Bragg reflection of CLC's periodical helical structures within the microdroplet's spherical confinement. Constructed PMCs with tunable size and composition have been successfully applied for monitoring the living cell extracellular temperature via co-incubation with cell suspension, and for detecting human body temperature via a flexible device from assembled PMCs. These PMCs could be flexibly applied in either micro-environment or large-area surface, enabling wide applications for precision temperature monitoring biological activities (e.g. cells or organs), optoelectronic devices working conditions (e.g. temperature indicators under extreme conditions), and etc.

Keywords : droplet, microfluidics, assembly, soft materials, microsensor
Conference Title : ICMN 2023 : International Conference on Microfluidics and Nanofluidics
Conference Location : Amsterdam, Netherlands
Conference Dates : August 03-04, 2023