In-situ encapsulated organophosphate hydrolase enzyme within the metal-organic framework structure for sensing of methyl parathion

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Organophosphates pesticides (OPPs) inhibit acetylcholinesterase enzyme (AChE) activity causing serious health implications. Present study reports the encapsulation of an organophosphate hydrolase (OPH) enzyme into a fluorescent Tb-BTC metal organic framework (MOF). The developed MOF-enzyme composite (OPH@Tb-BTC) was employed as a biosensor for the optical detection of methyl parathion in food and water samples taking it as a model OPs. The synthesized OPH@Tb-BTC composite was characterized using different analytical techniques such as UV-Vis, FTIR, TEM, TGA and XRD etc. The thermal and long term stabilities of OPH enzyme are both remarkably enhanced after encapsulation. The proposed MOF-OPH system has been proven to function as a very sensitive optical sensing probe for selective analysis of OPs. The lower limit of detection (LOD, 2.6 nM) makes Tb-BTC@OPH a better biosensor as compared to the reported enzyme based sensors for methyl parathion. As we have observed from our investigations, the encapsulation of OPH in Tb-MOF is characterized with main advantageous features, namely enhancement of enzyme activity and recycling. The OPH@Tb-BTC exhibited high enzymatic activity and better reusability (successfully reused upto five cycles). After 5th cycle, OPH@Tb-BTC system showed 40% reduction in its sensing response. The optimum performance of biosensor was estimated at pH (8.0), incubation time (5 min) and temperature (40 °C). Thus, the proposed OPH@Tb-BTC has as a very sensitive optical sensing probe for selective detection of OPs in synthetic and real samples over wide linear dynamic range.

References

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Figures

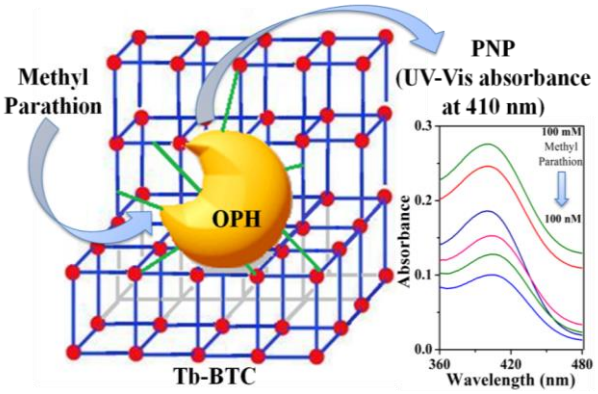

Figure 1. Schematic for enzyme-MOF composite based detection of methyl parathion.