Sol-Gel Encapsulation of Enzymes on Silica Based Supports as a Green Biocatalyst for Pharmaceuticals Degradation

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Biocatalytic degradation with the use of enzymes has gained great attention in the last years due to its advantages of high efficiency and environmental friendliness. The major drawbacks, such as low stability and non-reusability have been addressed in different studies and potential strategies were suggested to overcome these limitations. As such, immobilization on different silica based supports provides the possibility of enzyme reuse and prolonged stability in different operational conditions. Previously, a successful immobilization and subsequent removal of different pharmaceuticals, such as acetaminophen and diclofenac in presence of Cd(II) was performed in our group [1] using laccase crosslinking on Fe_3O_4/SiO_2-DTPA hybrid nanocomposites [1]. In another approach, peroxidase enzymes were first immobilized on magnetite nanoparticles, and later encapsulated within a surface silica layer using sol-gel method. The encapsulation of enzymes enhanced their thermal stability and improved the activity over 20 consecutive cycles for 20 days at 55^{o}C [2]. To produce cost-effective and green nanoadsorbents, in our latest work natural silicates were tested as enzyme substrates for core-shell immobilization techniques. With the natural silicate as a core and silica layer as a shell it was possible to encapsulate enzymes for removal and degradation of three different pharmaceuticals: diclofenac, carbamazepine and paracetamol. The biocatalysts demonstrated great oxidation rates for the selected pollutants. The enzyme acted differently in the three chosen supports due to their complex chemical composition which could have effect on overall enzyme activity.

References

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[2] I. V. Pylypchuk, G. Daniel, V. G. Kessler, G. A. Seisenbaeva, *Nanomaterials* **2020**, *10*, 282.