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A Review on Approaches for Enzyme Immobilization

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Abstract: ***Enzyme The enzymes are widely studied and explored area due to its abundant potential to cater wide application range which makes researchers to study more of this area. The high catalytic activity enabling ease in reactions formation of multiple products and byproducts or breakage of complex substances makes it an unavoidable option. However the cost of pure enzyme increases the economic burden on the operations obstructing its full fledged use. This leads to making enzyme restrict or immobilize within any inert matrix which can improve the reusability and also improve the tolerance against pH and temperature that can improve the activity of enzyme. Many different enzyme immobilization approaches are present in following article we have discussed some of the used approaches.***

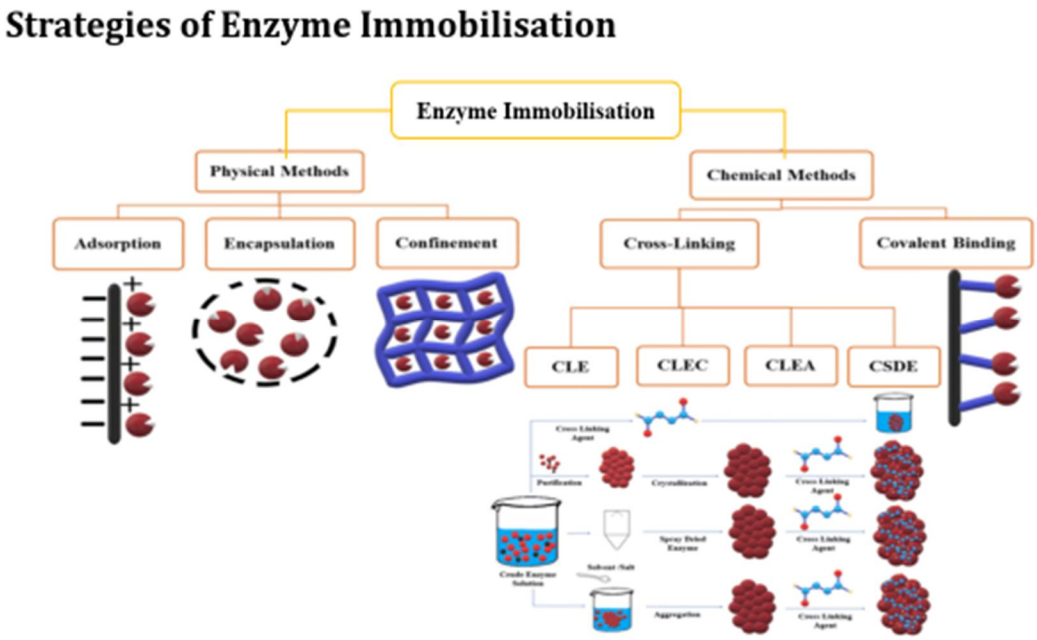


Fig1 : Strategies for enzyme immobilization

I. INTRODUCTION

Enzymes are widely used in various applications since ages in various fields such as food, pharmaceuticals, water treatment units, and many more as they increase the rate of reaction without them being getting consumed. However, it's cost and usability hinders it's wide application scope. The only one time use of pure enzyme and it's cost lets need to develop some immobilisation and entrapment strategies.

Since ages various enzyme immobilisation strategies have been used such as covalent linking, adsorption, entrapment, cross linked enzyme aggregates, nanomaterial linked enzyme and many more techniques.

The immobilisation of enzyme helps in reusability and increases and improves tolerance against extreme pH and temperature shifts. Hence, the process quality is improved with improved results and reducing economic stress on process.

Various researchers have tried various techniques for enzyme immobilization in order to overcome the drawbacks of existing techniques. The present article focuses on different enzyme immobilization strategies and its effect on enzyme activity and other operational factors such as pH and temperature affecting the process.

II. TECHNIQUES OF ENZYME IMMOBILIZATION

A. *Physical Adsorption*

The physical adsorption method is one of the direct methods of reversible immobilization that involve the enzymes being physically adsorbed or attached onto the support material generally carbon, silica base Matrix is used. Adsorption can occur through weak non-specific forces such as van der Waals, hydrophobic interactions and hydrogen bonds whereas in ionic bonding the enzymes are bound through salt linkages. The reversibly immobilized enzymes can be removed from the support under gentle conditions, a method highly attractive. This is because of economic reasons as the cost of the support is often a primary factor in the overall cost of immobilized catalysts.

B. *Entrapment*

Entrapment is defined as an irreversible method of enzyme immobilization where enzymes are entrapped in a support or inside of fibres, either the lattice structure of a material or in polymer membranes that allows the substrate and products to pass through but retains the enzyme. It can be used for raising mechanical stability and can be also used for the reduction of leaching events of enzymes. Since the enzyme in this process does not interact chemically with the polymer/ material of the support fibers/lattice, it remains protected from denaturation with time.

C. *Chemical*

Cross-linking

Cross-linking is another irreversible method that does not require a support material for the attachment of enzyme molecules. In this technique, the molecules of enzymes are covalently bonded to each other to create a matrix consisting of almost only enzyme. The reaction ensures that the binding site does not cover the enzyme's active site, the activity of the enzyme is only affected by immobility.

D. *Covalent Bonding*

The enzyme is bound covalently to an insoluble support (such as silica gel or macroporous polymer beads with epoxide groups). This approach provides the strongest enzyme/support interaction, and so the lowest protein leakage during catalysis. The activity of the enzyme being covalently bound is dependent on several factors including: shape, and size of carrier material, coupling method type, the composition.

E. *Recent Approaches*

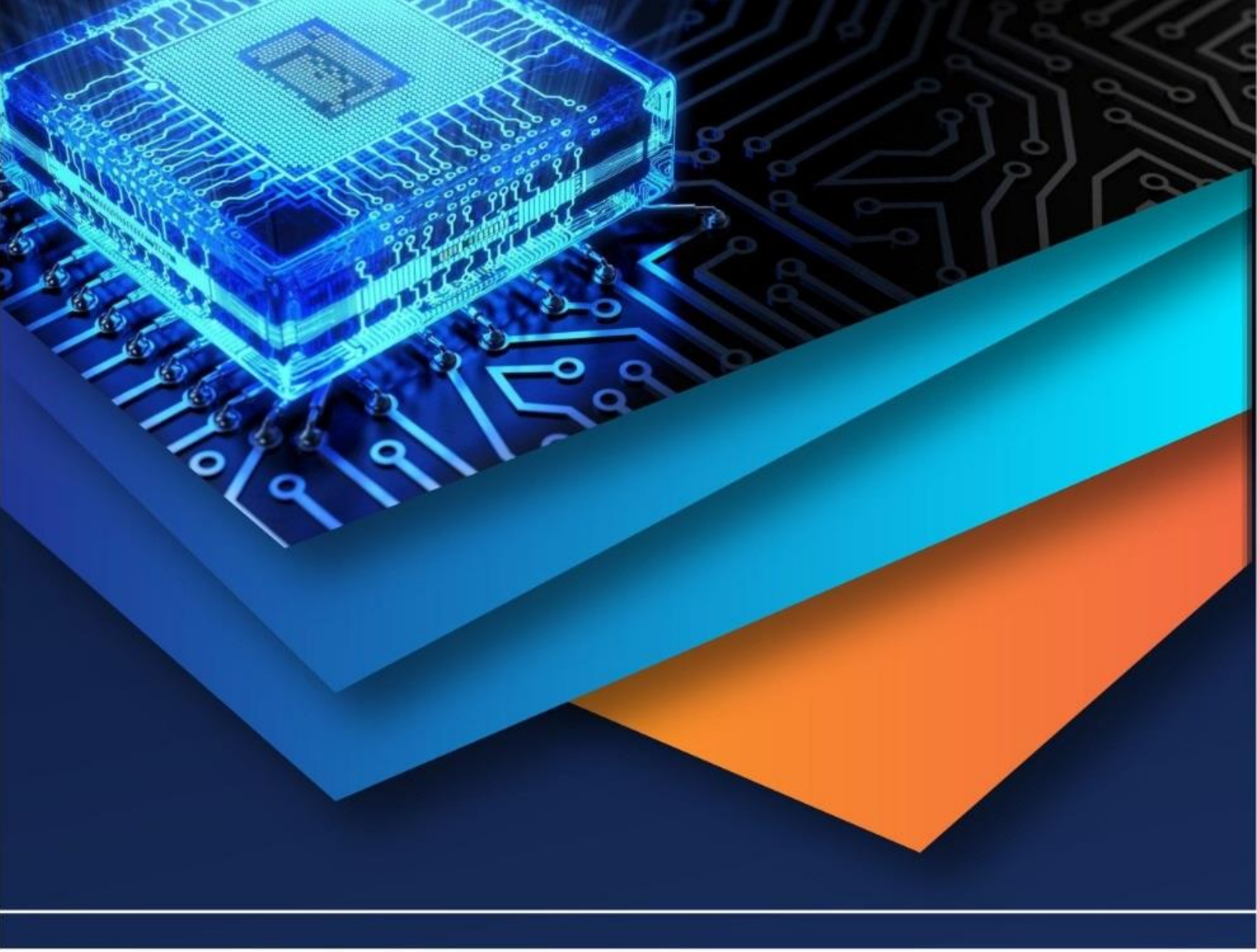
The entrapment modifications leading to recent techniques such as metal organic frameworks where enzyme is entrapped within metal ions cage with protein forming the linking agent of the cage and getting entrapped within. Nanoflowers name suggesting the flower like structure with protein forming the core and metal ions forming flower like structure where enzyme gets entrapped within. The use of magnetic properties enhances and adds on advantage for easy separation from reaction mixture with use of a magnet or just centrifuging the mixture.

REFERENCES

[1] Ma, W., Jiang, Q., Yu, P., Yang, L., & Mao, L. (2013). Zeolitic imidazolate framework-based electrochemical biosensor for in vivo electrochemical measurements. Analytical chemistry, 85(15), 7550-7557
[2] Liu, W. L., Yang, N. S., Chen, Y. T., Lirio, S., Wu, C. Y., Lin, C. H., & Huang, H. Y. (2015). Lipase□supported metal–organic framework bioreactor catalyzes warfarin synthesis. Chemistry–A European Journal, 21(1), 115-119.
[3] Jung, S., Kim, Y., Kim, S. J., Kwon, T. H., Huh, S., & Park, S. (2011). Bio-functionalization of metal–organic frameworks by covalent protein conjugation. Chemical Communications, 47(10), 2904-2906.
[4] Cao, S. L., Yue, D. M., Li, X. H., Smith, T. J., Li, N., Zong, M. H., … & Lou, W. Y. (2016). Novel nano-/micro-biocatalyst: soybean epoxide hydrolase immobilized on UiO-66-NH2 MOF for efficient biosynthesis of enantiopure ®-1, 2-octanediol in deep eutectic solvents. ACS Sustainable Chemistry & Engineering, 4(6), 3586-3595.
[5] Liu, X., Qi, W., Wang, Y., Su, R., & He, Z. (2017). A facile strategy for enzyme immobilization with highly stable hierarchically porous metal–organic frameworks. Nanoscale, 9(44), 17561-17570.
[6] Li, P., Modica, J. A., Howarth, A. J., Vargas, E., Moghadam, P. Z., Snurr, R. Q., … & Farha, O. K. (2016). Toward design rules for enzyme immobilization in hierarchical mesoporous metal-organic frameworks. Chem, 1(1), 154-169.
[7] Lyu, F., Zhang, Y., Zare, R. N., Ge, J., & Liu, Z. (2014). One-pot synthesis of protein-embedded metal–organic frameworks with enhanced biological activities. Nano letters, 14(10), 5761-5765.

[8] Shieh, F. K., Wang, S. C., Yen, C. I., Wu, C. C., Dutta, S., Chou, L. Y., … & Tsung, C. K. (2015). Imparting functionality to biocatalysts via embedding enzymes into nanoporous materials by a de novo approach: size-selective sheltering of catalase in metal–organic framework microcrystals. Journal of the American Chemical Society, 137(13), 4276-4279.

[9] Patil, P. D., & Yadav, G. D. (2018). Rapid in situ encapsulation of laccase into metal□organic framework support (ZIF□8) under biocompatible conditions. ChemistrySelect, 3(17), 4669-4675.



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