

## Surface and Solvent Engineering: Dual Approaches to Sustainable Protein Packaging

Green and nanostructured catalytic materials are essential in biocatalysis as they significantly reduce the denaturation of biocatalysts in extreme reaction environments. Our studies investigate the use of surface modification and solvent optimization techniques to preserve the conformational integrity of proteins.<sup>1-7</sup> Surface engineering techniques, such as the immobilization of proteins on functionalized solid matrices, were used to reduce protein aggregation, as well as improve the structural resilience of proteins. The use of tunable, green, ionic liquid, and deep eutectic solvent systems were investigated to stabilize the native structures and preserve the activity of proteins. A combination of these methods improved the folding of proteins, and their thermal stability and resistance to denaturation, all of which increased their catalytic activity against biotic and abiotic stresses.<sup>1,5</sup> The combination of surface and solvent engineering techniques provides a powerful strategy for developing proteins with improved catalytic activity and stability and has great potential for diverse applications such as industrial biocatalysis, pharmaceuticals, and bioengineering.

### References:

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### Short bio of Dr. Dibyendu Mondal

Dibyendu Mondal received his Ph.D. in Chemistry from CSIR-Central Salt and Marine Chemicals Research Institute in 2015 and completed postdoctoral research at CICECO-Aveiro Institute of Materials between 2015 and 2017. He served as an Assistant Professor at the Centre for Nano and Material Sciences from July 2017 to February 2024 and has been an Associate Professor there since March 2024. He was the ERA Chair holder of the NANOPLANT project at the Institute of Plant Genetics, Polish Academy of Sciences, where he currently serves as an Adjunct Professor and leading the Plant Nanotechnology team. His research focuses on biorefinery-based valorization of bio-resources, green solvents, protein engineering, biocatalysis, bioinspired nanostructures, and plant nanotechnology.