Article - BCM Initial Findings

Blend-Cleaver-Mini(BCM): Synthetic PET-Degrading Enzyme via AlphaFold

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Abstract

Currently, plastic waste, especially mixed-plastic PET streams such as labels, sleeves, tie-layers, or coatings, including co-polyesters, resist enzymatic cleanup. I designed Blend-Cleaver-Mini(BCM), a modular fusion enzyme that strips copolyester components and exposes base PET so downstream hot PETase can fully break down the micro plastics. Using the AI tool AlphaFold2 with its given metrics, I built and ranked variants BCM_v1 and BCM_v2, finding high-confidence domain folds and reduced inter-domain uncertainty after linker optimization. Dry tests and simulations suggest favorable results. Next, I will bring BCM into the world, running a wet lab where I will synthesize the protein and see it in action.

Background / Problem Statement

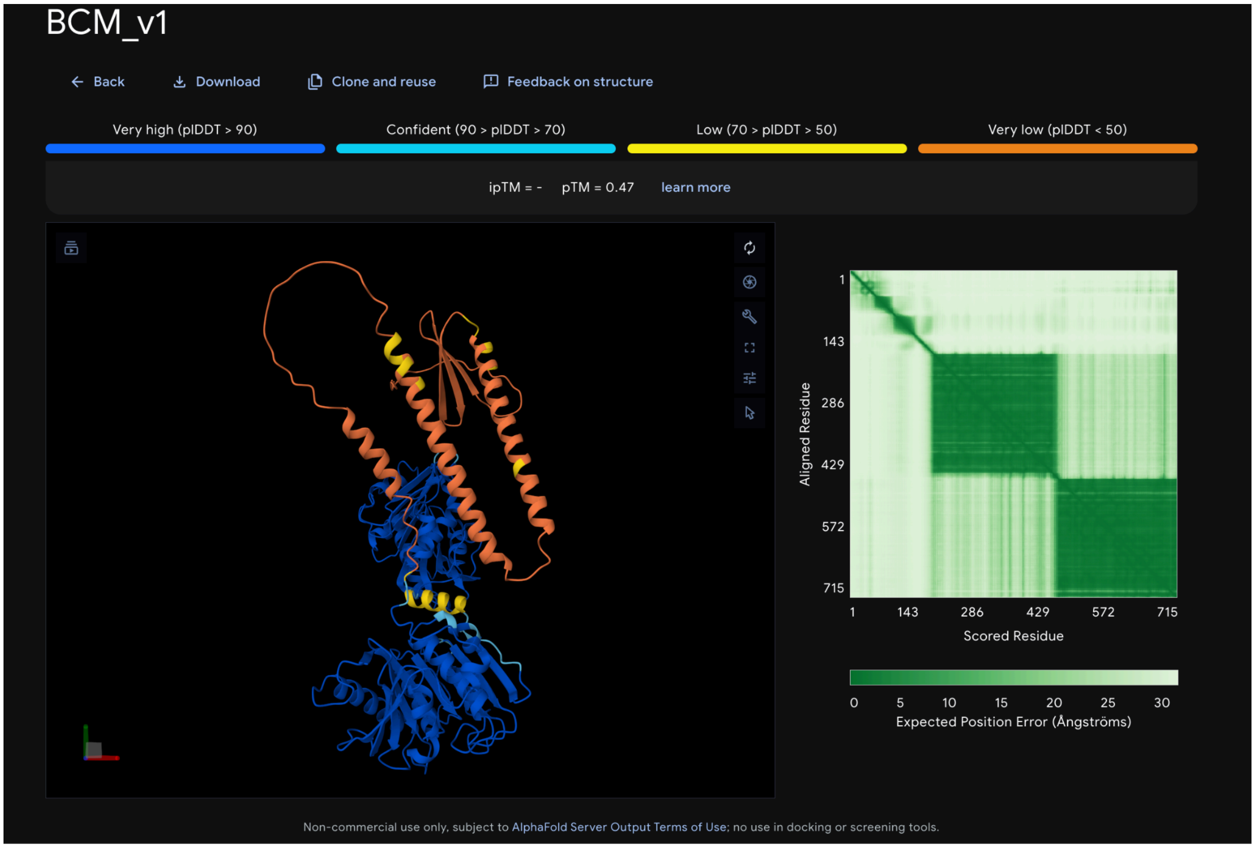
Microplastics are an environmental hazard; they tend to carry toxic chemicals and stay in your body after consumption, accumulating in your brain, organs, and directly injuring tissues. They also carry toxic chemicals and don't biodegrade. Enzymatic recycling is promising, but PETase alone struggles on high-crystallinity PET, multilayer packaging, adhesive-rich films, and blended copolyesters; surface binding is weak, and additives can inhibit activity. Inspired by recent advances in protein folding AI (AlphaFold) and generative tools, I sought to design a novel enzyme capable of PET binding and potential degradation.

Methodology

My key tools used for this project consisted of ChatGPT and AlphaFold2. ChatGPT helped me parse through databases to find what improvements I could make to the current microplastic-degrading enzymes. It helped me structure the amino acid chain BCM would use. Alphafold2 helped me build a 3d model of the protein once I had built the amino acid chain.

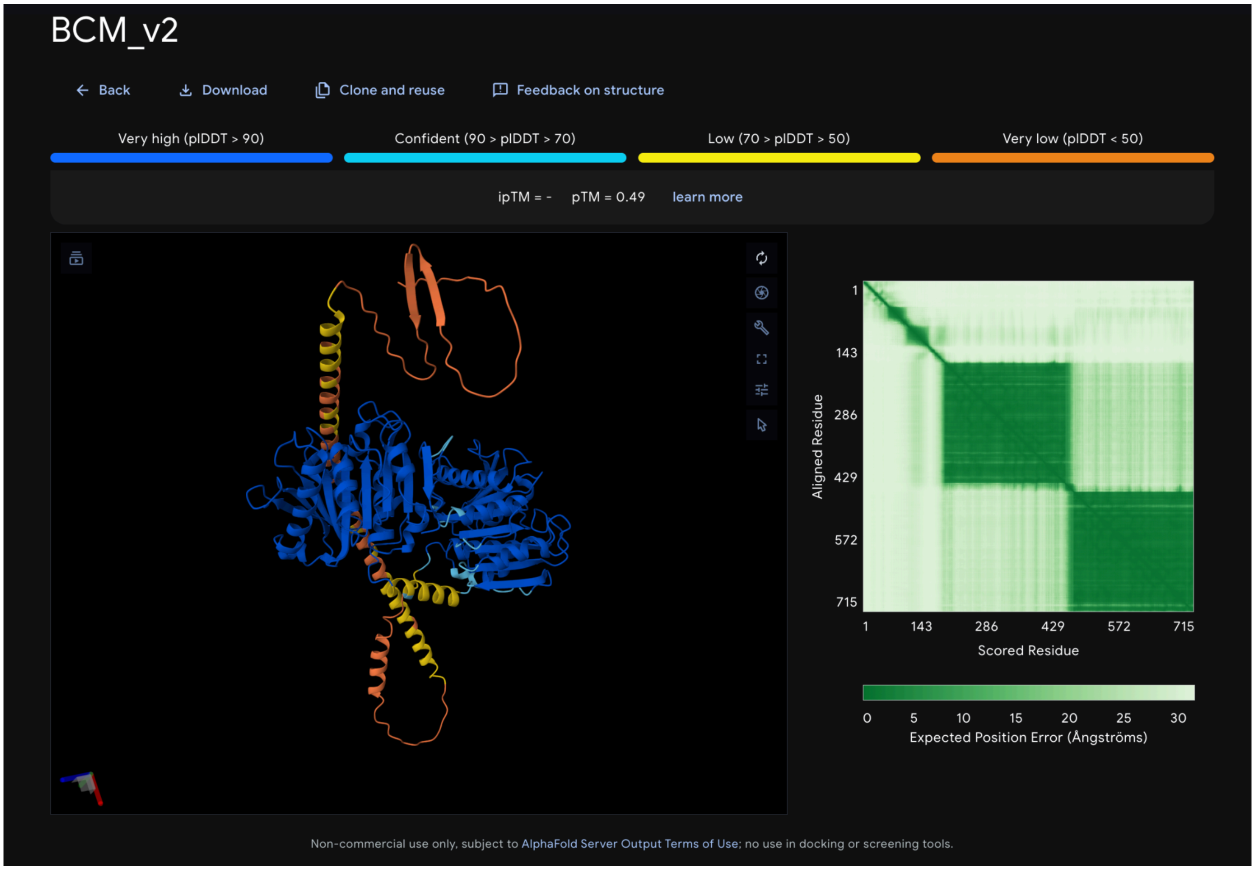
Findings / Results

AlphaFold models for BCM showed high confidence pLDDT in cores and lower pLDDT at linkers, with BCM_v2 displaying clearer definition and a modest rise in ranking confidence versus BCM_v1.



ipTM = - pTM = 0.47

Non-commercial use only, subject to AlphaFold Server Output Terms of Use; no use in docking or screening tools.



BCM_v2

ipTM = -   pTM = 0.49

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Limitations and Next Steps

This model is still untested in a lab, being a clear next step. I hope to bring BCM to life in a wet lab in the near future. I plan to synthesize the protein and run bench assays on PET/blend coupons

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