Efficient encapsulation of proteins with random copolymers

Trung Dac Nguyen, Baofu Qiao and Monica Olvera de la Cruz

Inside cells of living organisms, aggregates rich in disordered proteins organize the local environment to promote cellular functions. These membraneless organelles are able to concentrate enzymes and biomolecules to regulate interactions via the multiple conformations and compositions of disordered proteins. The interior of these organelles seems to behave akin to organic solvents. This opens the possibility of assembling synthetic organelles using random copolymers that mimic disordered proteins to disperse and stabilize enzymatic proteins in different environments, including organic solvents.

Here, we demonstrated that random copolymers with solvophobic and solvophilic groups can encapsulate numerous proteins, including ubiquitin (1UBQ), cutinase (1CEX), pseudolysin (1EZM), subtilisin (1A2Q), and Candida antarctica lipase B (1TCA) in basically any solvent. We found that the proteins are able to select the polymer sequences that best cover their surface both energetically and entropically. These protein-polymer aggregates are promising constituents of synthetic membraneless organelles.

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