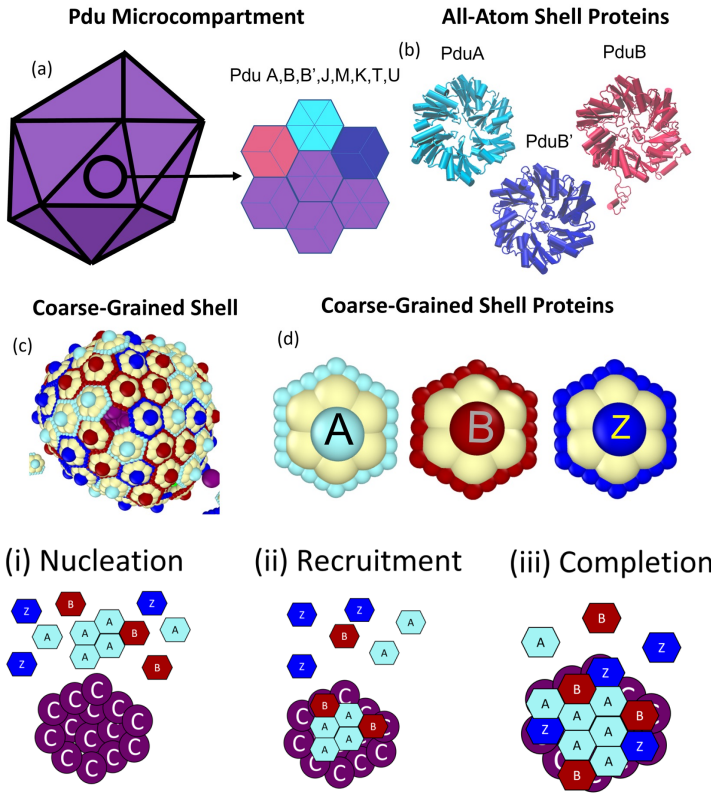
Assembly of Multicomponent Microcompartment Shells

We show that shells made of at least three types of shell proteins can assemble *via* a bulk-nucleated kinetic pathway which is inaccessible to shells with less than three shell protein species. These kinetic pathways also lead to shells with properties that are different from single-component shells including shells that encapsulate enzymatic cargo less tightly.

This sheds light on why nature might prefer to use more types of shell proteins in an assembly despite it requiring more genes to encode all the different shell proteins. There results will also inform synthetic design of microcompartments as nano-bioreactors in non-native environments.

- Coarse grained molecular dynamics showed how three component assemblies lead to successful assembly of microcompartments with few defects in regimes where one and two component assemblies were highly defective
- All-atom molecular dynamics was used to confirm that the range of interactions necessary in the coarse-grained model is present in the 1,2 propanediol utilization (Pdu) microcompartment system.
- Experiments showed significant deflation of microcompartments after undergoing dehydration in agreement with the coarse-grained model's prediction that a significant volume of water is encapsulated in the shell



Coarse-grained and all-atiom models of the shell proteins in the 1,2 propanediol utilization (Pdu) micrcompartment (a-d). Assembly proceeds via a 3-step bulk-nucleated mechanism (i-iii).

Waltmann, C.; Kennedy, N.W.; Mills, C.E.; Roth, E.W.; Ikonomova, S.P.; Tullman-Ercek, D.; Olvera de la Cruz, M. Kinetic Growth of Multicomponent Microcompartment Shells; ACS Nano. 2023. Just Accepted.

Northwestern

We thank the financial support of the CBC-NU Cell-free Biomanufacturing Institute funded by the U.S. Army award W52P1J-21-9-3023]