

Barley stripe mosaic virus-like particles as biotemplates for mineralization of metallic nanoparticles

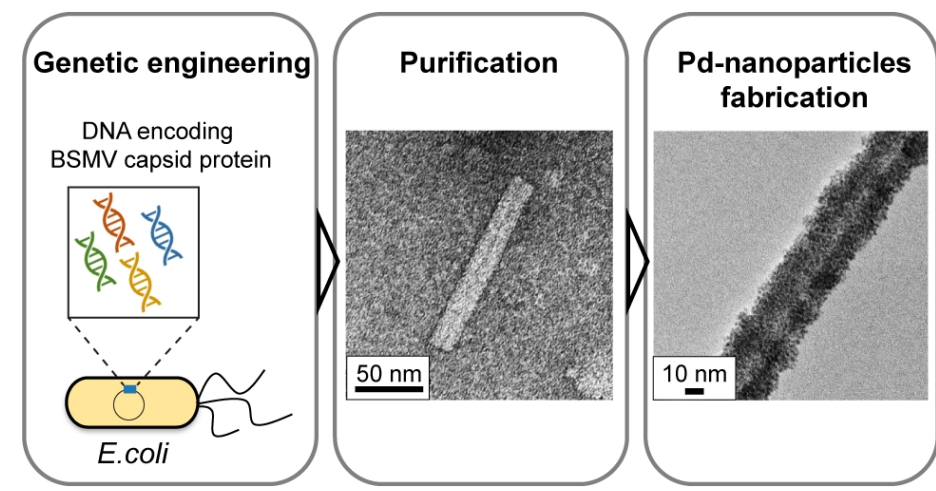
Kevin Solomon

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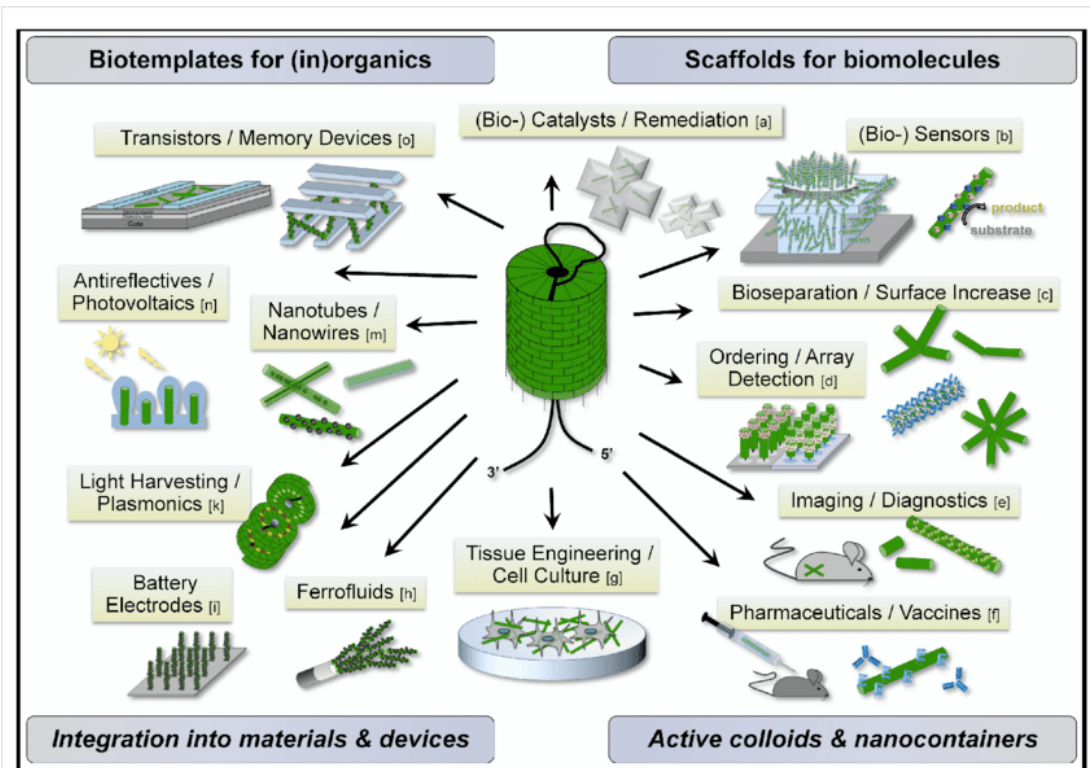
University of Delaware

 <http://solomonlab.weebly.com>

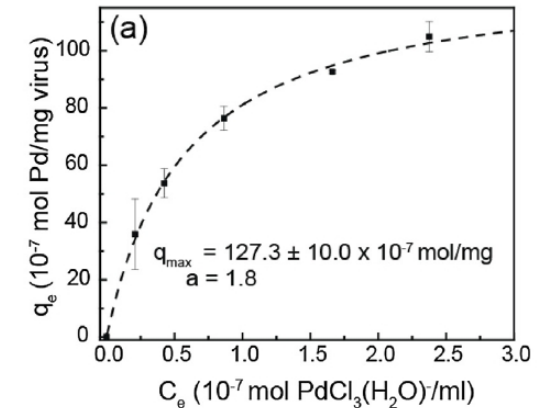
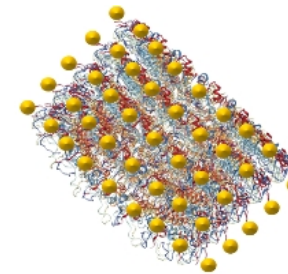
 @drksolomon



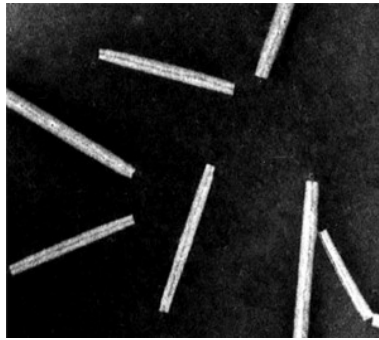
Biohybrid inorganic nanoscale materials can be synthesized via viral templates



Green hydrothermal synthesis possible in the *absence* of an external reducing agent at milder temperatures (50 °C)



Barley stripe mosaic virus (BSMV) as a novel biotemplate for metallic nanorods

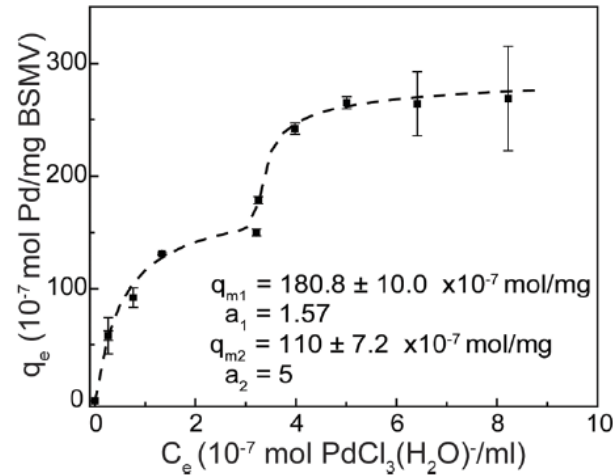


Virus Taxonomy, 2012

length: 110-150 nm

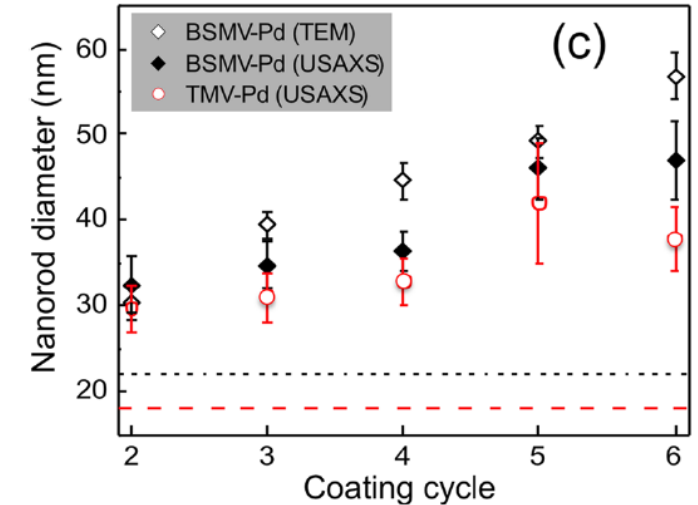
diameter: 20 nm

internal diameter: 3.5 nm



BSMV surface has both electrostatic and van der Waals interactions

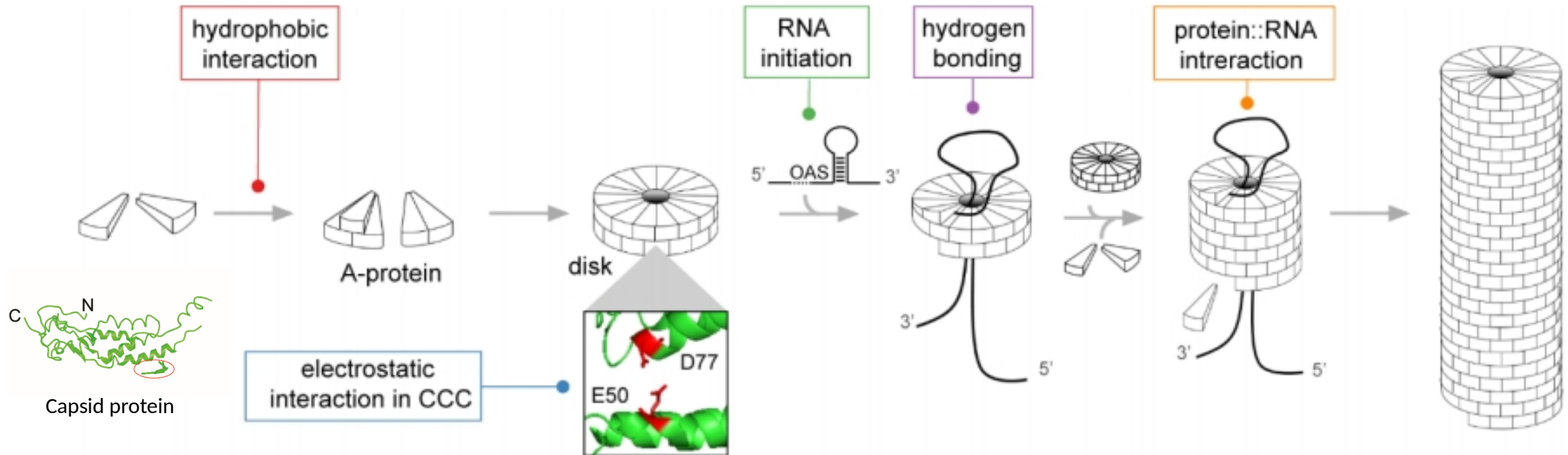
- Faster coating process
- **Less waste**



Adigun et al, (2017) Langmur

How do we create non-infectious BSMV virus-like-particles (VLPs) that can be engineered to control nanoparticle properties?

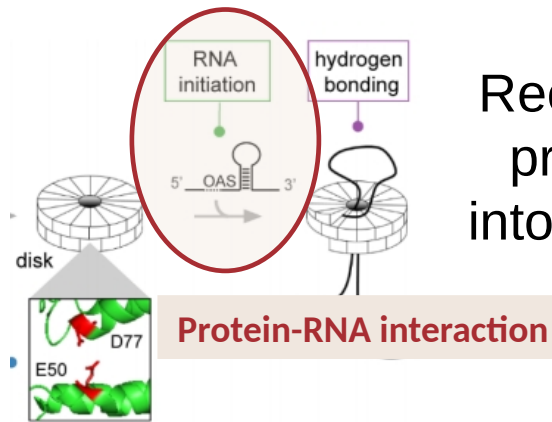
BSMV production requires nucleic acid and protein interactions



Bacterial expression system enables production of BSMV-VLPs with desired properties

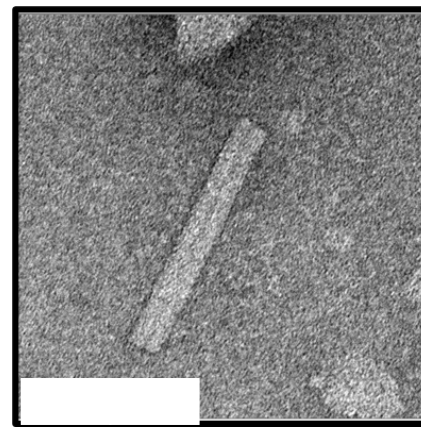


Kok Zhi Lee

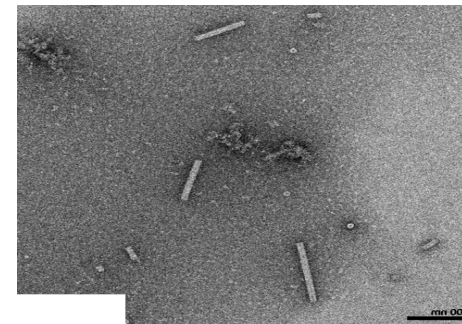


Recombinant BSMV coat protein self-assembles into disks and rod VLPs in *E.coli*

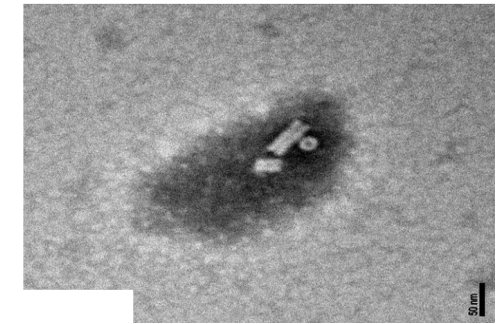
Site-directed mutagenesis to insert **single amino acid** at surface-exposed C-terminus for surface display



Scale bar: 100 nm



lysine



cysteine

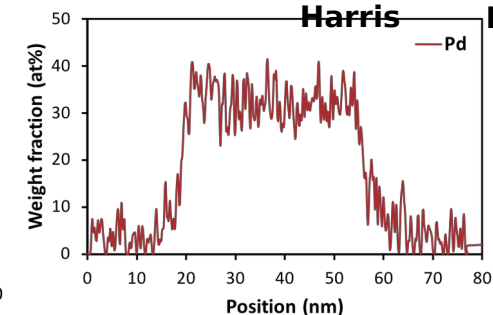
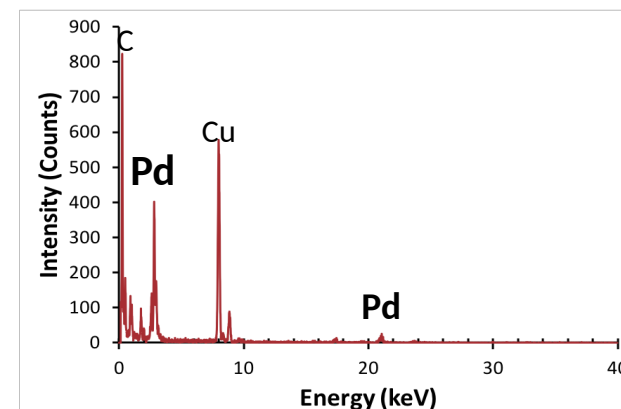
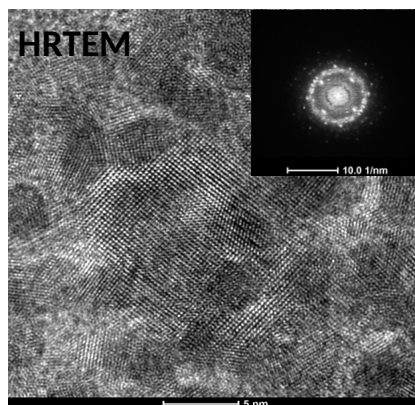
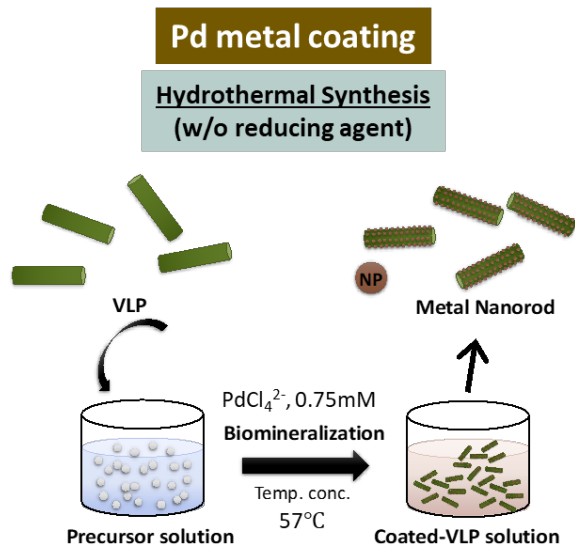
VLPs can be mineralized with noble metals to form devices



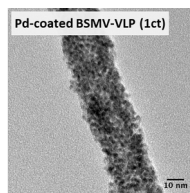
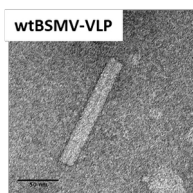
Prof. Mike Harris



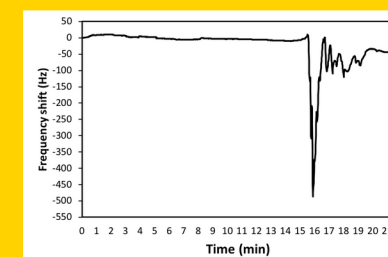
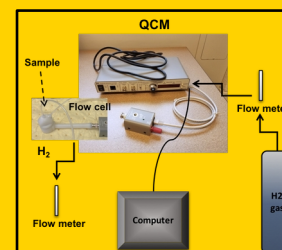
Yu-Hsuan Lee



- Large-scale uniformity
- Dense and fully-coated single layer Pd rod
- High crystallinity
- Tunable Pd-nanorod diameter via number of coatings
- Bimetallic alloy nanorods possible

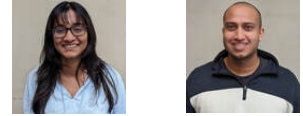


Pd-coated VLPs as hydrogen sensors via a quartz crystal microbalance

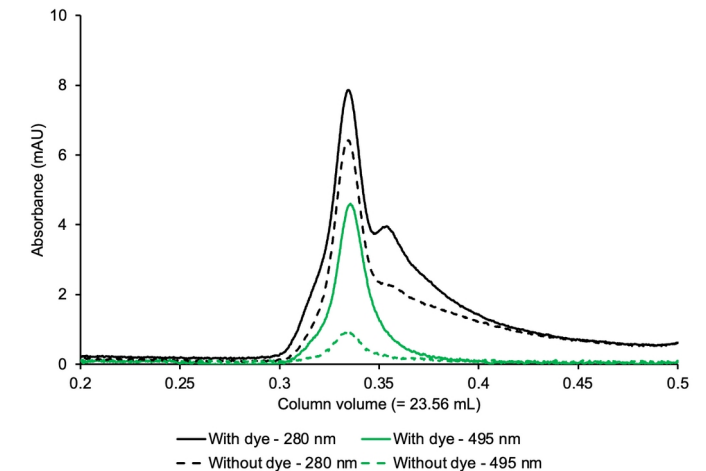
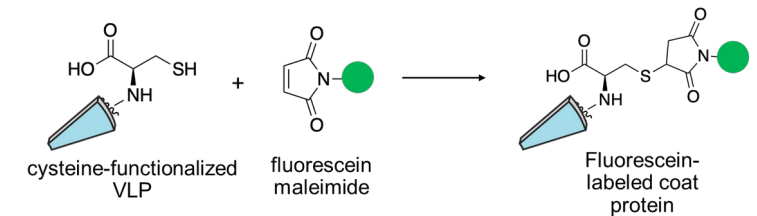
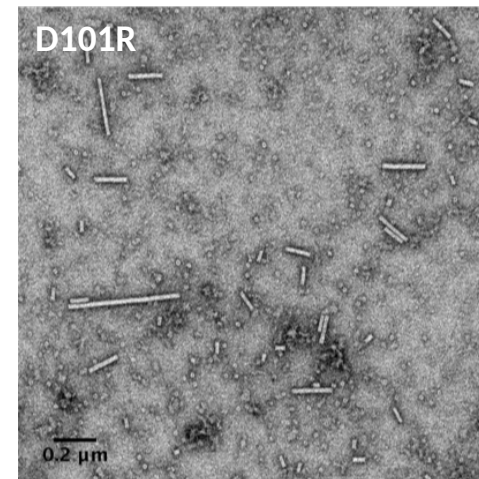
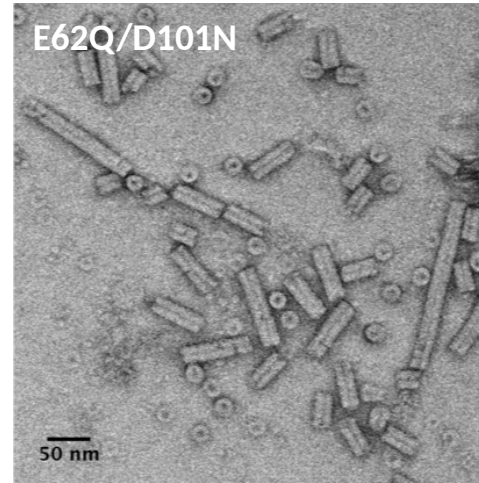
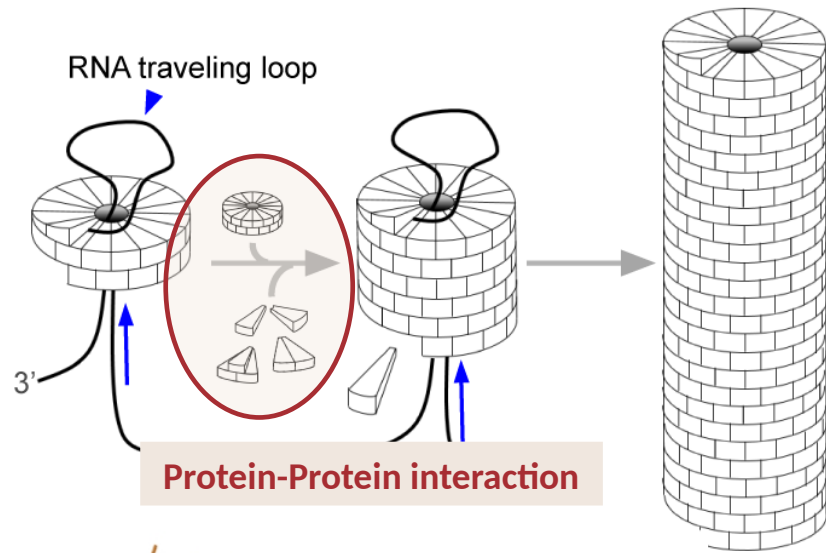


YH Lee, KZ Lee *et al.*, *ACS Appl Nano Material.* 2020
 YH Lee, PhD Dissertation, 2021

Engineering protein-protein interactions enhance pH stability increasing surface functionalization options

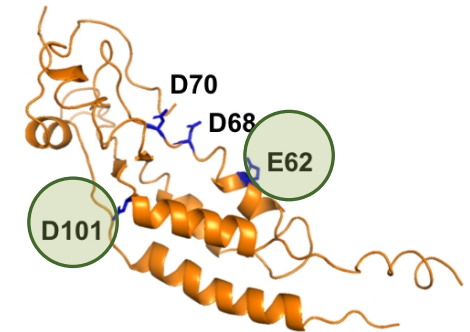
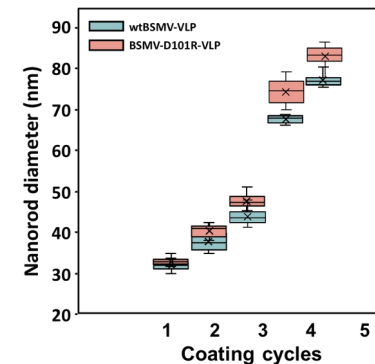
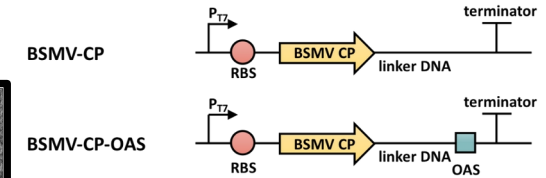
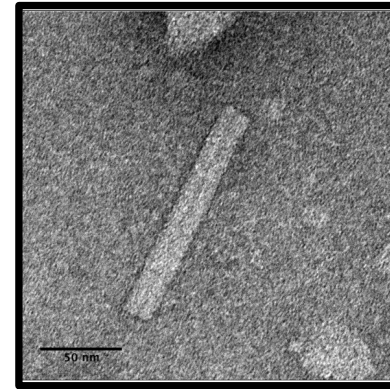


Mruthula Rammohan **Akash Vaidya**



Engineered VLPs as biotemplates for nanoparticle synthesis

- Bacterial BSMV-VLP production enables engineering
- Synthetic biology provides opportunities to functionalize/enable novel nanomaterials
- Green synthesis of Pd nanorods of **high coverage and great density**



Acknowledgements



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