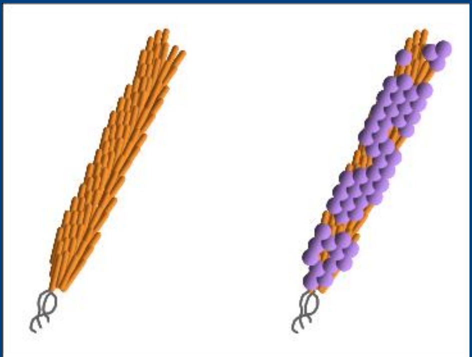
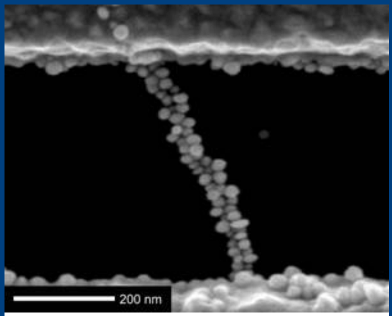
Bio-Templating: The M13 Filamentous Virus



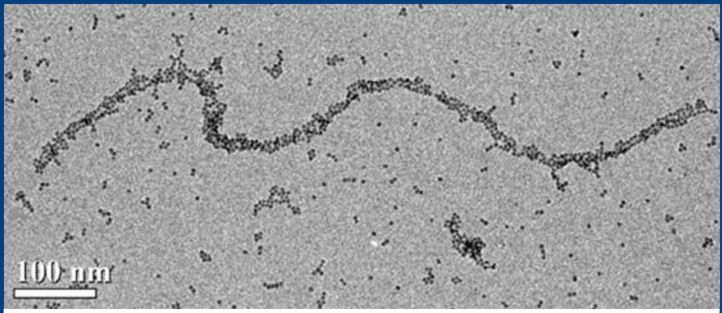
A schematic of a genetically-modified, M13 viral template (left) and a viral template with selectively bound nanoparticles (right).

Bottom-up assembly techniques mimic processes in the natural world to arrange nanoscale components into larger scale structures. Such techniques are capable of precise assembly of devices on the nanometer scale, as well as building novel nanoscale or heterogeneous materials. The Haberer Lab uses the M13 filamentous virus, a biologically-based template, to assemble materials for electronic and optoelectronic applications from the bottom up.

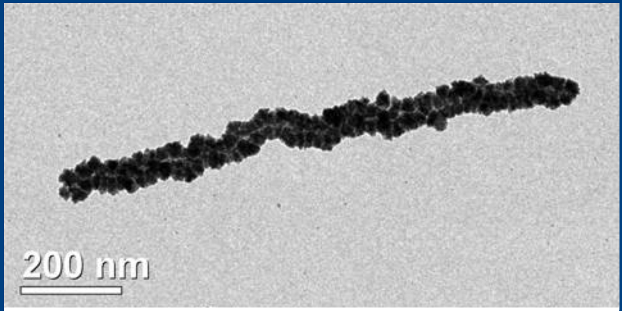
Although it is rather challenging to manipulate nano-sized components using man-made tools, the M13 virus is quite capable of creating complex, highly organized nanostructures. The M13 virus is made up of DNA encapsulated in a protein coat which is just under a micron long and approximately 6 nm in diameter. Instructions for the assembly of the protein capsid are encoded within the DNA. With the appropriate genetic modification, the protein coat of the M13 virus can be programmed to recognize, selectively bind, nucleate, and grow selected inorganic materials of technological significance. The M13 acts as a modifiable scaffold for building nanoscale architectures and materials with precise spatial and compositional control.



A scanning electron micrograph of a viral-templated gold nanowire



A transmission electron micrograph of a viral-templated CdSe nanoparticles.



A transmission electron micrograph of a viral-templated gold nanowire.

Current efforts in the Haberer Lab are targeted towards using the M13 viral template to synthesize new, multi-component nanoscale materials to address challenges including solar power generation, hydrogen storage, high gain materials, and sensitive optical switches.