Nanoscaled monolayer assembly of M13 viruses on polyelectrolyte multilayers

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A novel means of incorporating ordered bio-functional viral assemblies into an electrostatic thin film nano-assembly has been demonstrated. We used negatively-charged engineered M13 bacteriophage (virus) as the adsorbant species on a weak polyelectrolyte multilayer support consisting of a cationic linear polyethyleneimine (LPEI) and anionic polyacrylic acid (PAA). Due to a unique phenomenon of interdiffusion, the LPEI/PAA multilayer provides full mobility to the M13 virus, and the adsorption process drive self-assembly and entropically-driven ordering. The resulting monolayer formation of M13 virus can be tuned for its packing density and directional alignment. Furthermore, we demonstrate the two-dimensional biomineralization from this monolayer template of M13 virus for nanoparticle and nanowire assembly. Electrostatic binding of cationic gold nanoparticles to the capsid body of a negatively charged M13 generates a well-ordered one-dimensional quantum dot array and nucleation of cobalt ions at the surface of M13 virus enables the two-dimensional assembly of cobalt nanowires on the surface.