Ultrathin water layers on soft surfaces

Dr. Alexander Bittner

CIC nanoGUNE (BRTA) Tolosa Hiribidea 76, E-20018 Donostia - San Sebastián

Abstract:

Nanoparticles with organic shells, lipid bilayers, and similar systems can emulate viruses during transmission, when they are in contact with surfaces and (humid) air. This allows my group to work with a multitude of methods, which are - as of today - out of scope of most virology labs: AFM and environmental SEM, and (in cooperation) neutron reflectometry, fluorescence correlation, IR/Vis sum frequency generation.

How viruses "survive" in dry environments is of great relevance to e.g. influenza virus particles, which are coated by lipid bilayers. We found that the typical hemagglutinin "protein spikes" are crucial: They stabilize lipid layers by preserving an ultrathin water layer even at ambient humidity (40%). The same "protein spikes" carry hydrophilic sugar moieties, which we model with mannosylated gold nanoparticles. They, too, retain ultrathin water layers (1 to 2 nm), but only at high humidity (90%, of little relevance for transmission).

Moving closer to the real world, we work with (harmless and simple) plant viruses. The best known, Tobacco Mosaic Virus, "survives" complete dehydration, but features a water layer (<5 nm) at ambient humidity. Upon drying, we found a complex, but reversible reconstruction of the otherwise highly symmetrical protein surface.