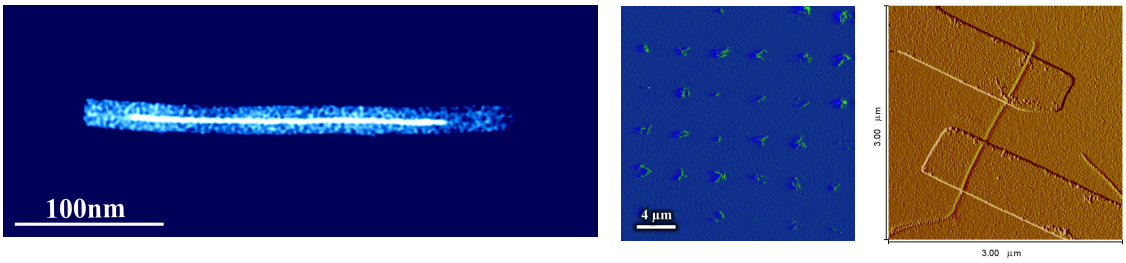
Composites of Tobacco Mosaic Virus with Metal Clusters and Wires

Alexander M Bittner, [a] Sinan Balcı, [a] Anan Kadri, [b] Christina Wege, [b] Holger Jeske, [b] Klaus Kern
[a]

[a] *Max-Planck-Institute for Solid State Research, Nanoscale Science Dept., Stuttgart, Germany;*
[b] *Stuttgart University, Molecular Biology and Plant Virology, Stuttgart, Germany.*

Many biomolecules have a size that is very well suited for nanoscale science: 1 to 10 nm. Their shapes are so attractive for experiments and applications that some unusually stable molecules have opened up exciting new fields, especially as templates for metallic nanostructures. Relatively large, but well-defined and regular structures, can form by self-assembly of proteins in vivo and in vitro. Plant virus coats are prime examples for this process. Their chemical stability allows applying a range of inorganic synthesis procedures for ionic, covalent and metallic structures. Even electroless metallization from aqueous solutions containing metal complexes and reductants becomes feasible.

Tubular viruses such as the Tobacco Mosaic Virus are excellent templates for linear nanostructures such as aligned metal clusters, narrow wires, and tubes. Coatings, clusters and 3 nm wide, hundreds of nm long cobalt, nickel and copper wires can be produced inside and on the Tobacco Mosaic Virus. A combination with spatially selective transfer by soft lithography ("top-down") allows placing soft matter/cluster composites on a surface with nanometer precision, while the electric conductivity of viruses and virus/inorganic composites is investigated by electron beam lithography contacting.



From left: Cobalt wire (white) inside a tubular plant virus; microcontact-printed viruses (bright spots); electrically contacted linear assembly of viruses (line extending from lower left to top)