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"Perspective" paper

AFM nanoindentation of protein shells, expanding the approach beyond viruses

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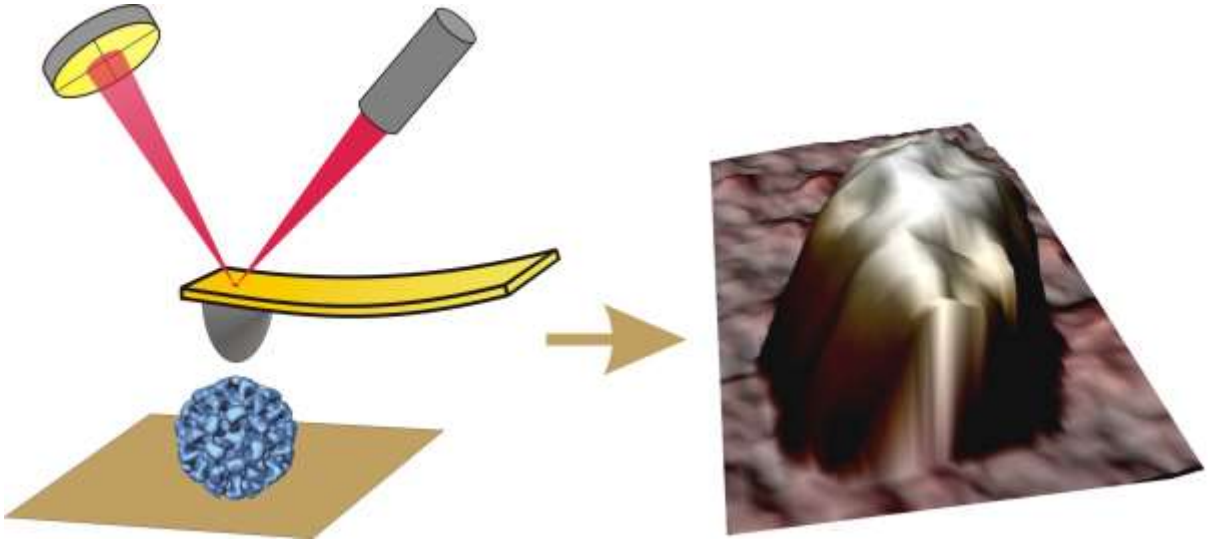
Graphical abstract



Abstract

The archetypical protein nanoshell is the capsid that surrounds viral genomes. These capsids protect the viral RNA or DNA and function as transport vehicle for their nucleic acid. The material properties of a variety of viral capsids have been probed by Atomic Force Microscopy. In particular nanoindentation measurements revealed the complex mechanics of these shells and the intricate interplay of the capsid with its genomic content. Furthermore, effects of capsid protein mutations, capsid maturation and the effect of environmental changes have been probed. In addition, biological questions have been addressed by AFM nanoindentation of viruses and a direct link between mechanics and infectivity has been revealed. Recently, non-viral protein nanoshells have come under intense scrutiny and now the nanoindentation approach has been expanded to such particles