3.3 ANTI-VIRAL NANOPARTICLES AND NANOCOATINGS

Viruses constitute a group of heterogeneous and much simpler organisms. They range in size from 100-300nm, much smaller than bacteria. Viruses are unique in that they have no independent metabolic activities and have to rely solely on infection living hosts to reproduce themselves. Unlike all other life, viruses may contain either DNA or RNA as genetic materials, but not both.

The nucleic materials are surrounded by a protein coat to protect them from harmful agents in the environment. The protein coat also provides the specific binding site necessary for the attachment of virus to its host. Some viruses also contain an outer envelope made up of lipids, polysaccharides, and protein molecules. The lipids and polysaccharides are of host cell organ, and their presence allows a virus to fuse with a host cell and thus gain entry.

A virus not having the outer envelope infects a cell in quite a different manner. Infection is initiated by the attachment of a specialized site on the surface of the protein coat of the virus onto a specific receptor site on the surface of the host cell.

Once this binding is complete viruses can release genetic materials into the host cell and take advantage of the machinery of the host cell to reproduce and assemble themselves. These newly produced viruses are now ready to infect other cells.

Therefore, one of the key processes to disable viruses is through the control of their surface structure, especially their binding sites, so they can no longer recognize the receptor site on the host cells. As many types of nanocoatings attack most effectively on the virus's surface, they represent an excellent viable technology to destroy the viruses surface structure. Functionalized nanoparticles can affect the viruses due to chemical interactions between the molecules-functionalizers and molecules-receptors at the virus surface.

Nanoparticles that display anti-viral action include:

- Nanosilver (NanoAg).\(^3\) \(^4\) \(^5\) \(^6\)
- NanoGold (NanoAu).\(^7\) \(^8\)
- Nanoparticle titanium dioxide (Nano-TiO\(_2\)).\(^9\)
- Nano Copper(II) chloride (NanoCuCl\(_2\)).\(^10\)
- Nano Cerium Oxide (NanoCeO\(_2\)).\(^11\) \(^12\) \(^13\) \(^14\)
- NanoSilica (Nano-SiO\(_2\)).\(^15\)
- Graphene oxide.\(^16\)
- Nano Zinc Oxide (NanoZnO).\(^17\)
- Carbon nanotubes.
- Fullerenes.
- Chitosan nanoparticles.

Nanoparticles are effective against different viruses: