TUNING OPTICAL PROPERTIES AND AQUEOUS SOLUBILITY OF PROTEIN-METAL NANOTUBES BY THIOL SURFACE MODIFICATION

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Introduction The design and production of nanomaterials for specific and desirable applications relies on the ability to modify their properties at the nanoscale[1]. Our group has demonstrated that it is possible to decorate rotavirus VP6 protein nanotubes with different metals and different coverages extents[2]. These nanocomplexes have conductive, catalytic and optical properties with potential applications in electronic or sensor fabrication. However their use in the biomedical area is limited since they lack stability in aqueous solutions. The dispersibility on water of the metal-VP6 nanotubes can be increased by coating its surface with charged molecules or polymers, but this coating can alter the particular properties of the nanocomplexes.
In this study we determined the possibility to coat the surface of VP6-metal nanotubes, increasing their stability in water but maintaining their optical properties.

Methods VP6 nanotubes were produced in the insect cell-baculovirus system and purified by chromatography. Gold functionalization of the nanotubes was carried as reported[2]. 3-Mercapto-1-propanesulfonic acid sodium salt (MPS) was used for coating the nanostructures. The properties of complexes were analyzed to determine morphology, plasmon resonance, and Z potential.

Results Different molar ratios of MPS to Au were used for functionalization. It was found that the content of MPS substantially modify the characteristic properties of naked VP6-metal nanostructures. Plasmon resonance, that typically appear at wavelength of 530 nm suffered a shift and appeared at 510 or 500 nm, or disappearing when Au and gold were in the same quantities in the nanostructures. This correlated with the decrease in nanoparticle size that was less than 2 nm in the higher MPS quantities. It is known that no plasmon resonance is detected in nanoparticles of this size.

In the case of aqueous dispersbility that was measured as Z potential, the better stabilized nanostructures were those with higher content of MPS, as summarized in table 1.

Table 1. Physical properties of nanocomplexes obtained with gold and MPS as coating.

MPS/ Au ratio	Nanoparticle Dia. (nm)	λ max. absorp. (nm)	Z Potential (mV)
0	5.4 ± 1.3	530	-12.6
0.25	4.7 ± 2.2	510	-15.7
0.5	4.1 ± 0.9	500	-36.2
1	2 ± 0.7	--	-32.2
2	< 2	--	-29

Comparison between naked and coated nanostructures is shown in figure 1.

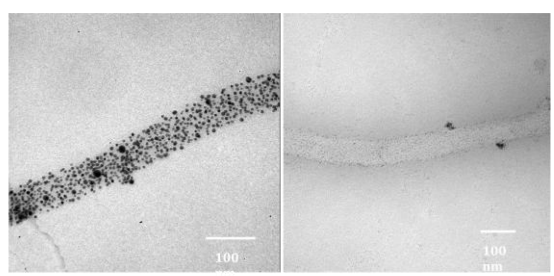

Fig.1 TEM micrographs of naked (left) and MPS coated nanostructures (ratio=1).

Conclusions Here we showed that it is possible to tune the properties of VP6-metal nanocomplexes through surface modification.

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References

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