Magnetic Liposomes entrapping Target - Hollow Magnetic Nanoparticles for Bio-medical Applications: Imaging, Neutron and Photodynamic X-ray Therapy of Cancer

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Liposomes are hollow nanoparticles from biogenic lipids, which are suitable well for biomedical applications because of their immunotolerance and bio-degradability. While simple liposomes entrapping target material in the inner volume have been used as drug carriers and early Neutron capture therapy applications, problems occurred due to the low biological life time and the low local concentration (www.bnct.org). We improved the method tremendously by introducing metals in the nanostructure [1-3, www.MPSD.de]:

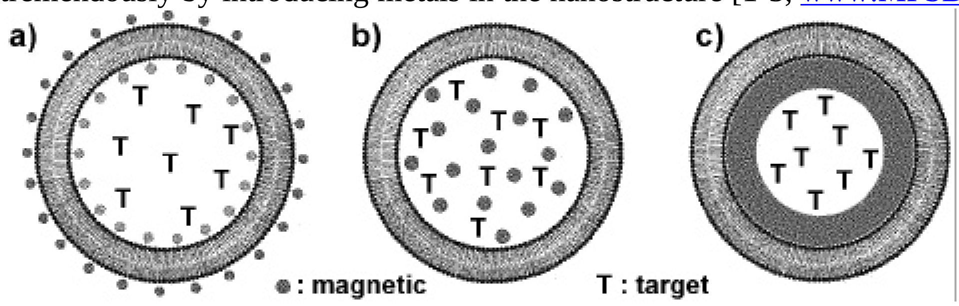

Figure 1: Magnetic liposomes with entrapped target (T) and three types of magnetic structure.

As shown in fig.1, the magnetic metal was introduced in the metallo-liposomes by three methods: **a)** bound to the lipid layer as metal-head lipid, investigated at ESRF-ID01 and DESY-HASYLAB-B1 [1]; **b)** entrapped in the lumen of the liposomes as soluble complex or sub-nanoparticles; or **c)** in magnetic shell liposomes bearing a lipid - metal oxide double layer shell, as studied at ILL-D22 [2,3]. The structure and dynamics during synthesis was investigated by ASAXS, dynamic light scattering DLS, time resolved Neutron scattering TR-SANS and electron microscopy TR-EM with our stopped-flow technique [3, 4].
If the metal is applied as a magnetic compound, the method results in magnetic liposomes, which can be magnetically dragged or concentrated selectively in the body area of interest, e.g. a tumor in cancer therapy or an imaging area. Further material can be co-entrapped for therapy, diagnostics or analysis. We entrapped successfully water-soluble target material in the lumen: organic compounds, metal chelates, Borate and (better) the Boron compounds BGB, BBG and BBT [3]. This enables the magnetic liposomes for imaging, neutron capture (NCT with B, Gd, ^{7}Li), and photodynamic therapy with Synchroton radiation, with Gd, Iodine or cis-Platinum [5], a source of Auger electrons under irradiation. In the latter two cases the magnetic liposomes with entrapped radiation target can supply a local radio-therapy with secondary radiation of very short range (< 30 µm), i.e. a few cell diameters.

References

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