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Self-assembled porphyrazine nanoparticles interaction with albumin by dynamic light scattering

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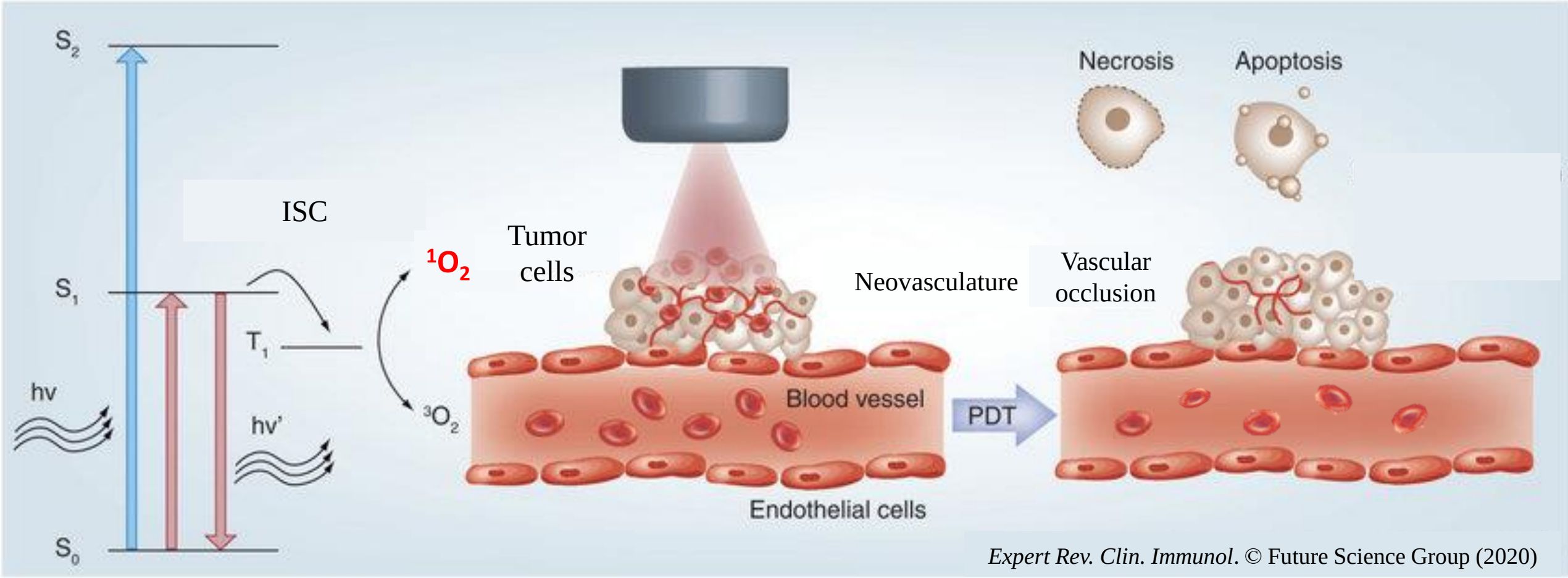
Introduction

Photodynamic therapy



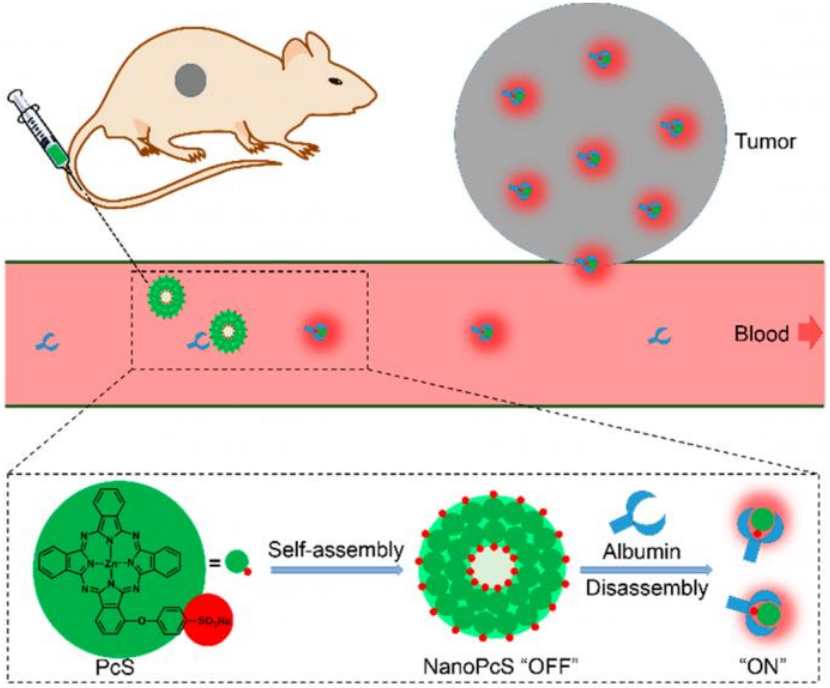
Vascular occlusion is a blockage of a blood vessel

Delivery of nanoparticles

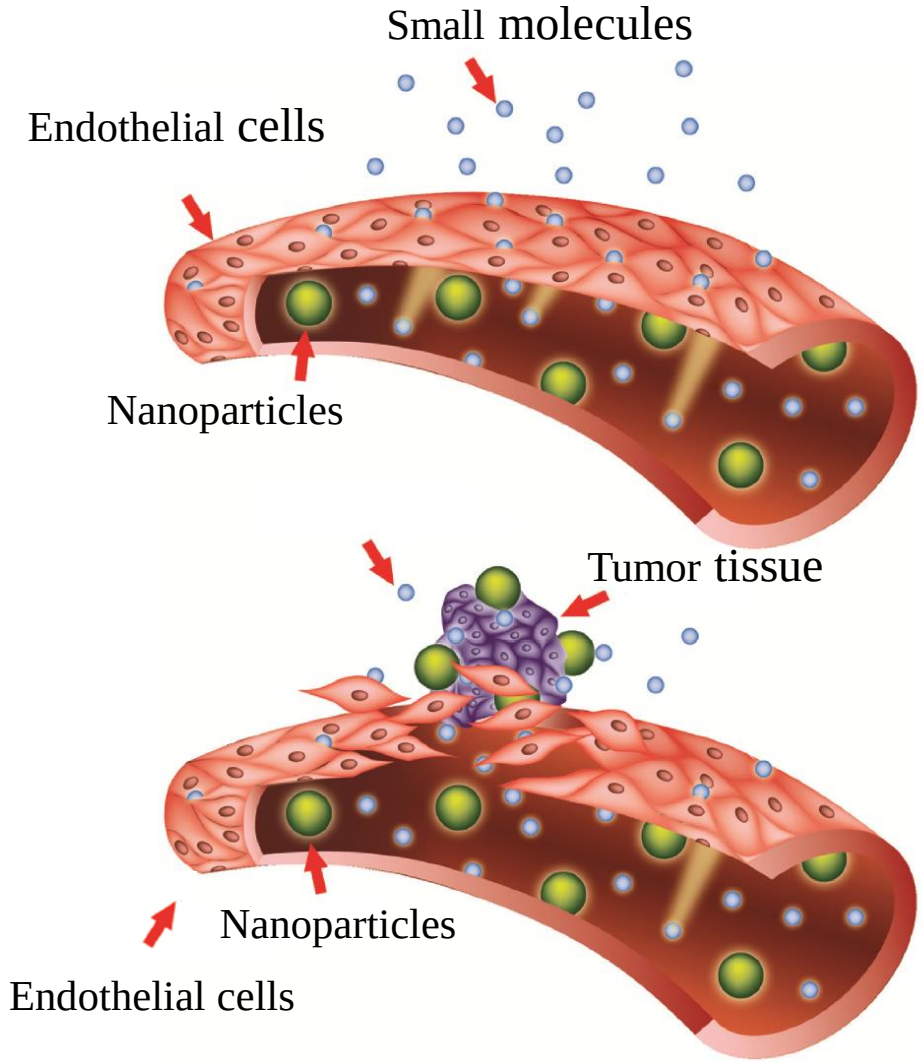
Theoretically, there are two main types of passive targeting:

(1) Albumin extensively used as a drug delivery carrier. Albumin can trap the porphyrazine molecule from nanovesicle and induce its disassembly, leading to switchable photoactivity.

(2) Tumor vessels contain large gaps between endothelial cells: this structural characteristic allows nanoparticles (NPs) to reach the tumor cell matrix through the EPR effect.



(1) *Chem. Soc*. Traps Photosensitizer Monomers from Self-Assembled Phthalocyanine Nanovesicles (2019)



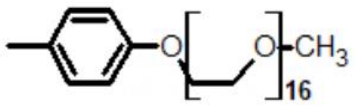
(2) *Chem. Meth. Inst*. Liposomes as nanomedical devices **(**2020)

Research objects

The objects of study were provided by the laboratory of phthalocyanines and their analogues of the Institute of Physiologically Active Compounds of the Russian Academy of Sciences (IPAC RAS)

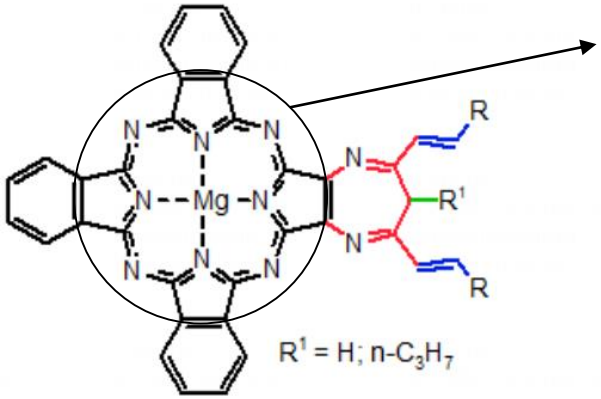
Objects of study

Porphyrazine

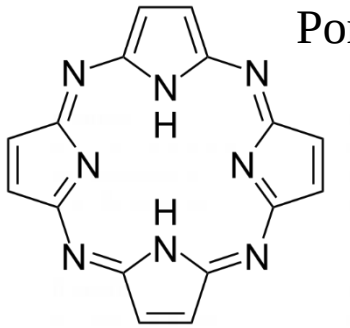


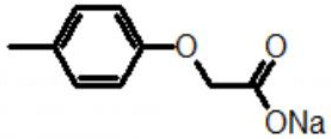
(a) **R** for PT_peg

polyethylene glycol group



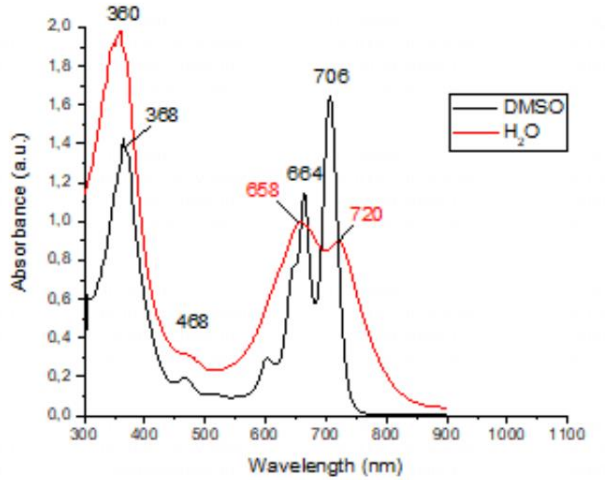
The porphyrazine structure

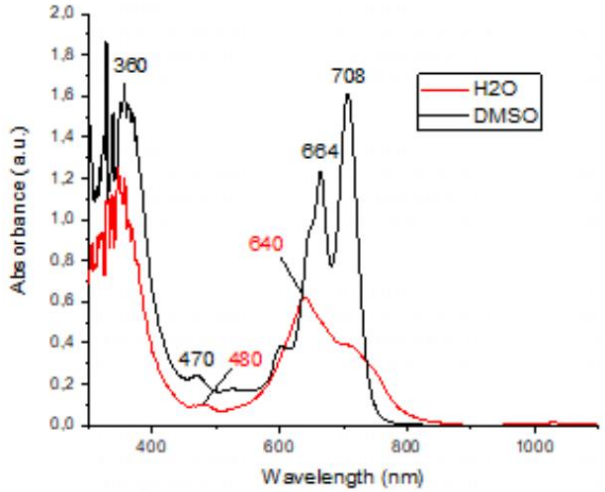




(b) **R** for S27_Na

carboxylic group

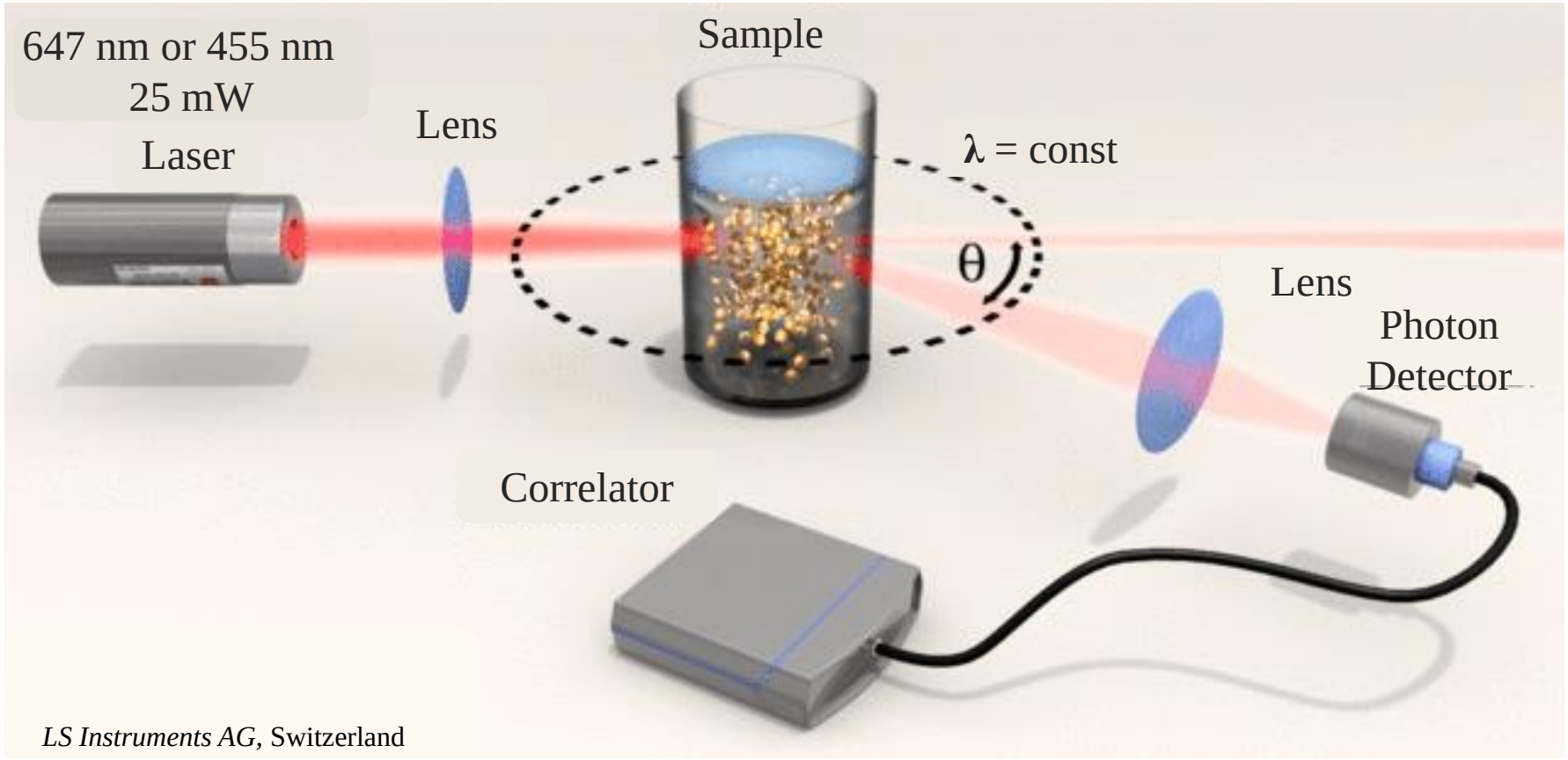




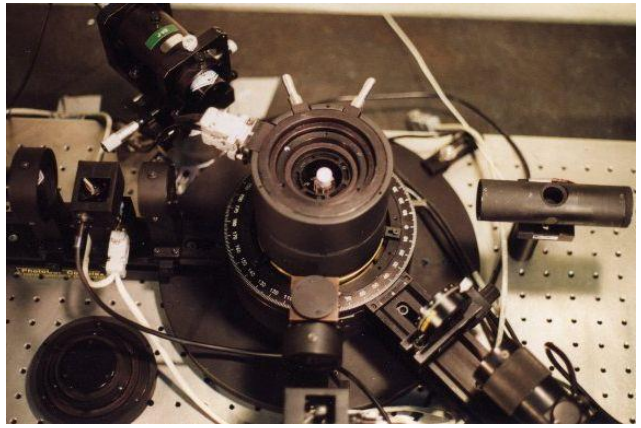
The absorption spectras of NPs (a) PT_peg and (b) S27_Na

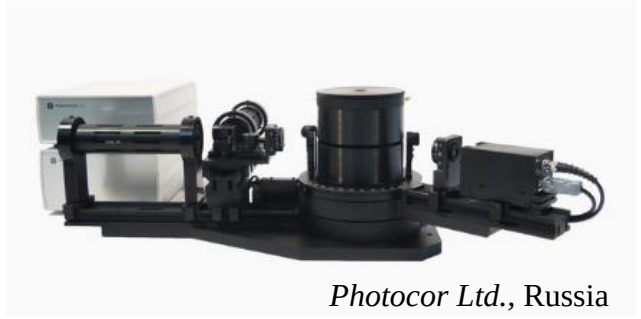
Research method

Dynamic light scattering DLS



LS Instruments AG, Switzerland





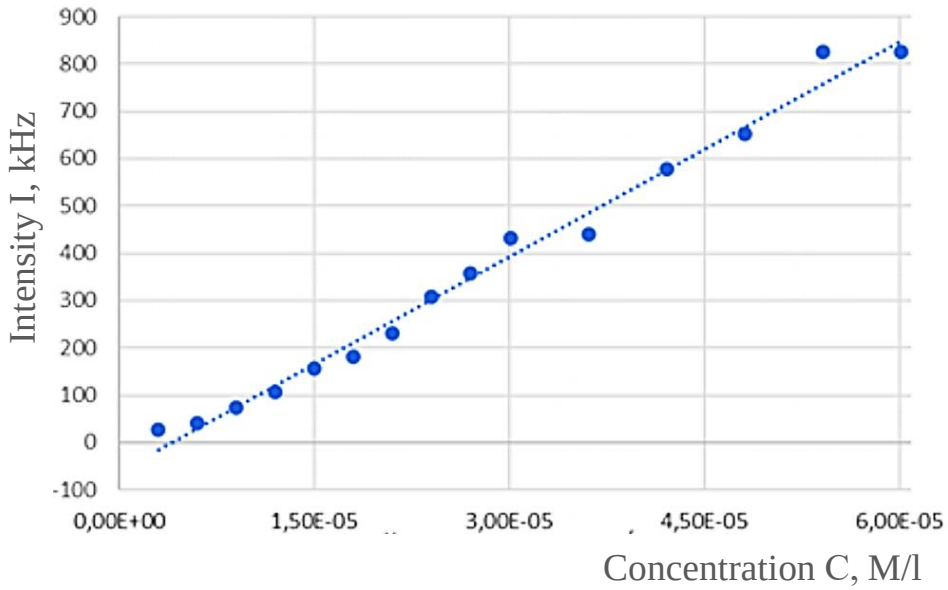
Photocor Ltd., Russia

The Photocor Cómplex is a particle size analyzer based on the dynamic light scattering method.

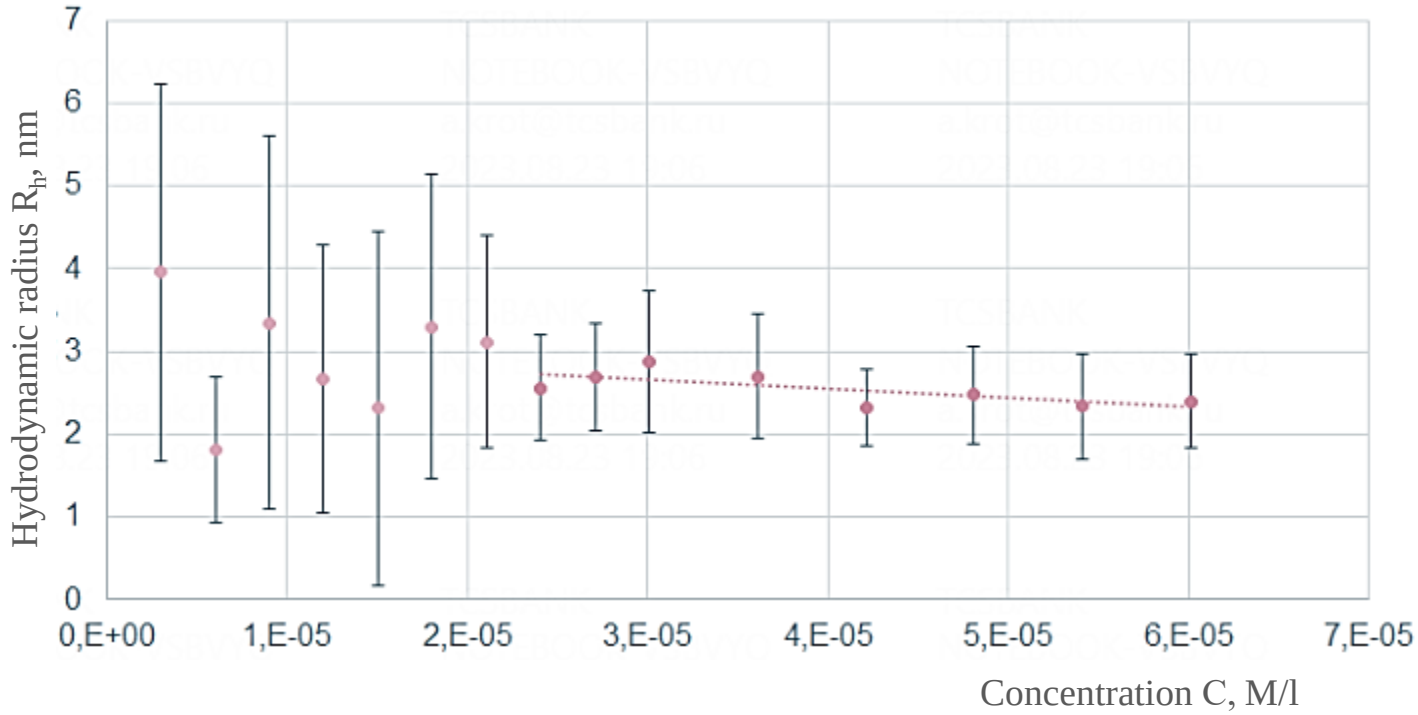
Results

DLS size analysis. HSA.

Scattered light intensity as a function of albumin concentration in water



Albumin radius as a function of its concentration in water



Rayleigh scattering law

$$I \sim C$$

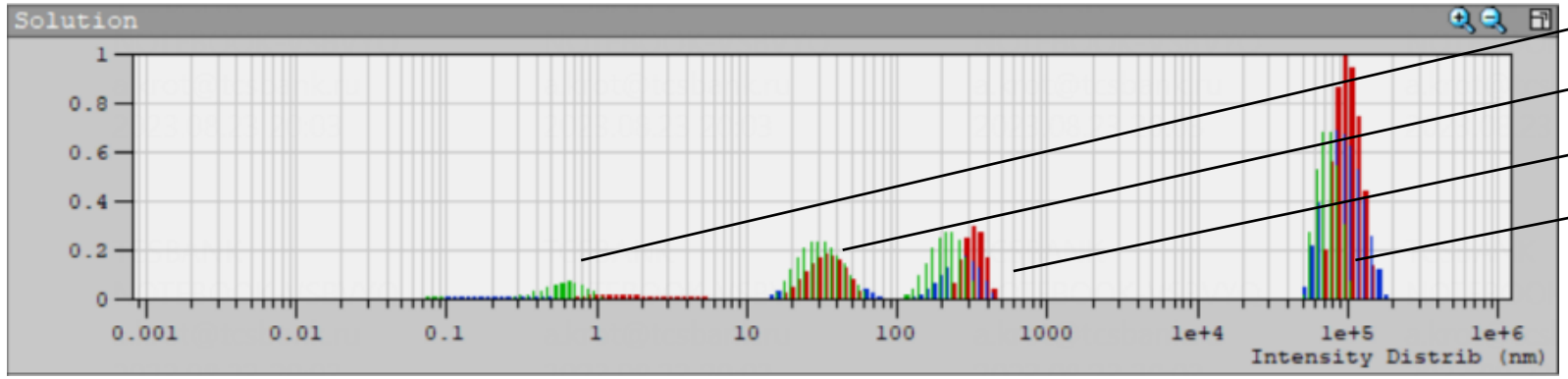
$$< R_{alb} > = 3{,}6 \pm 0{,}9\ nm$$

All nanoPCLs sizes.

Sample	Main sample sizes, nm	New peak with albumin	Interaction
HSA	3,6±0,9 36±10	-	-
PT_peg without PVP	45±14 112±37	-	not found
PT_peg with PVP	90±28 197±40	400 nm (as PVP-HSA interaction)	revealed
S_27_Na without PVP	92±38 336±24	215 nm	revealed
S_27_Na with PVP	62±23 162±36 339±52	many peaks	revealed

In this case, **polyvinylpyrrolidone** (PVP) acts as a nanoparticle **size stabilizer**, as well as a **passive load** (a therapeutic drug can be used instead). **PVP is known to weaken π–π stacking**. Thus, in the extreme case (S_27 Na with PVP) - the nanoparticles are disassembled by the protein (HSA): PVP interacts with the protein separately and we get a large number of sizes that are difficult to distinguish.

Real S_27_Na with PVP size distribution. DLS.



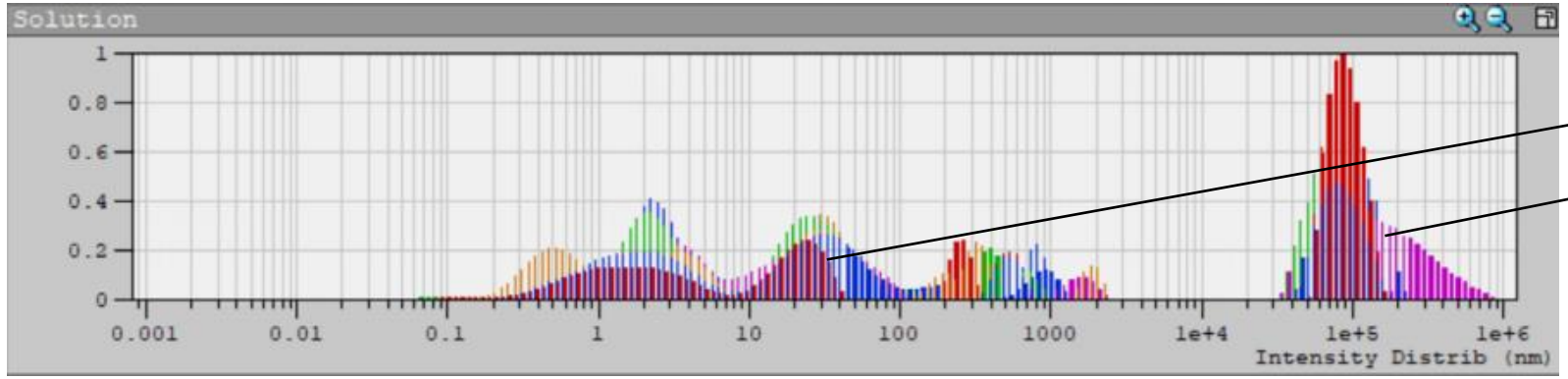
water artifact pike

S_27_Na pike size

S_27_Na pike size

PMTs artifact pike

S_27_Na with PVP separately



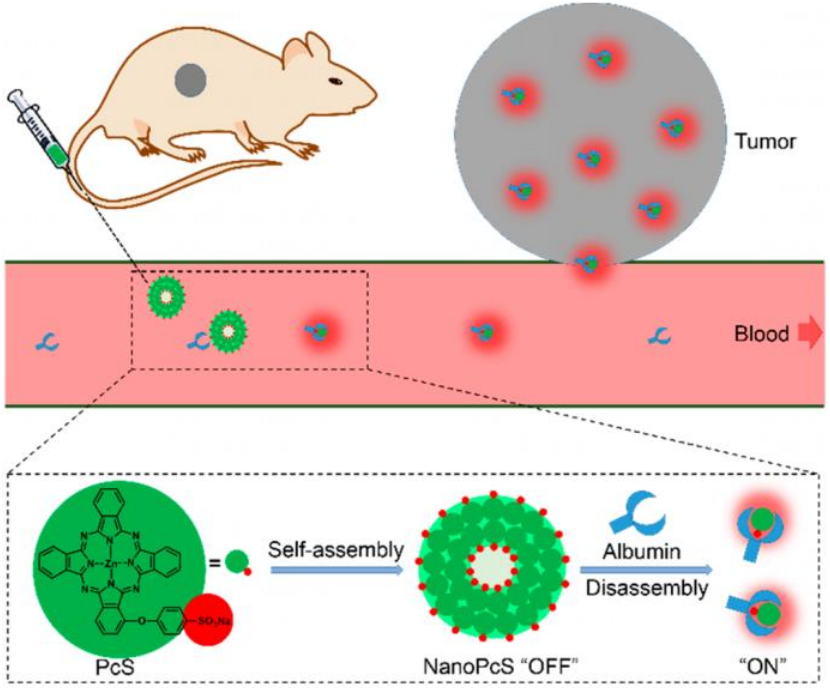
Unresolvable peaks distribution

PMTs artifact pike

S_27_Na with PVP and HSA

Conclusion

Thus, taking into account all possible types of interaction, we obtained combinations of self-assembled nanoparticles - photosensitizers with various types of interaction with the main human transport protein (HSA), which can be used depending on the need to deliver a particular drug.



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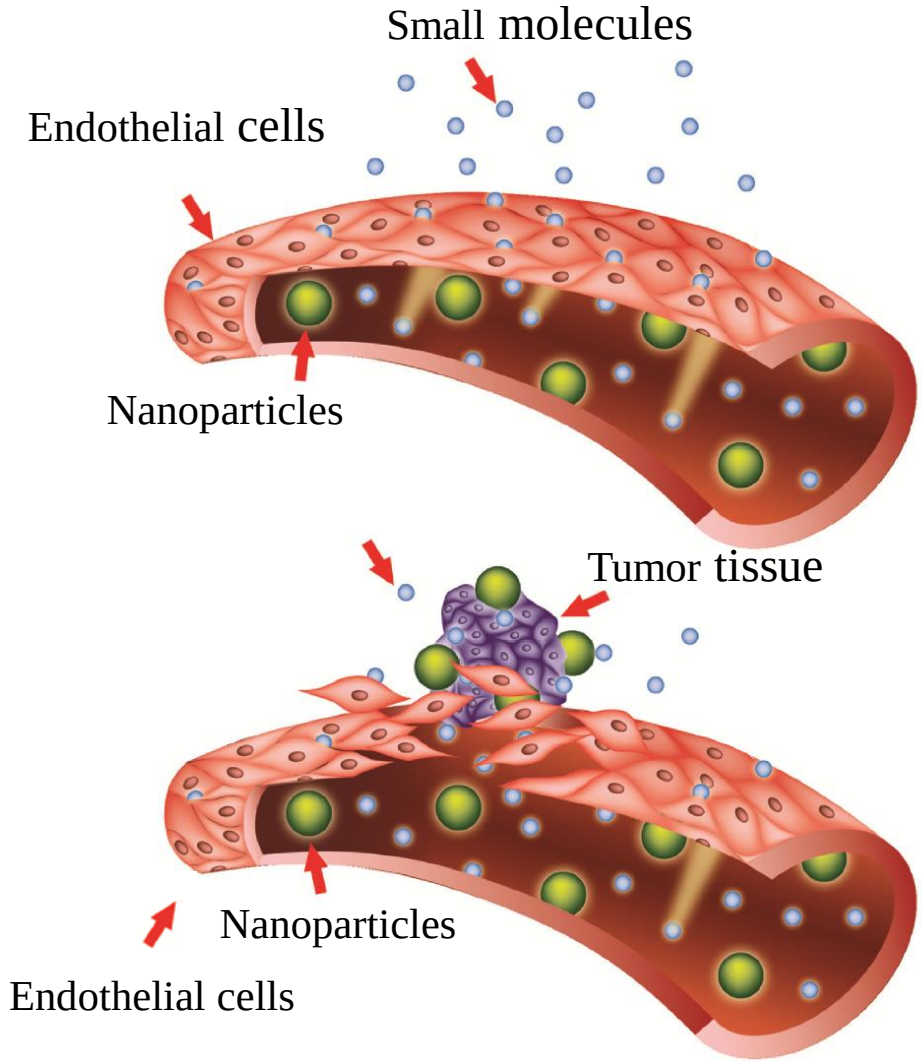

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Thank you for your attention!

Contacts

Group of anisotropic liquids and solutions

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