Development of effective strategies for radionuclide incorporation into $CaCO_3$ particles for *in vivo* studies

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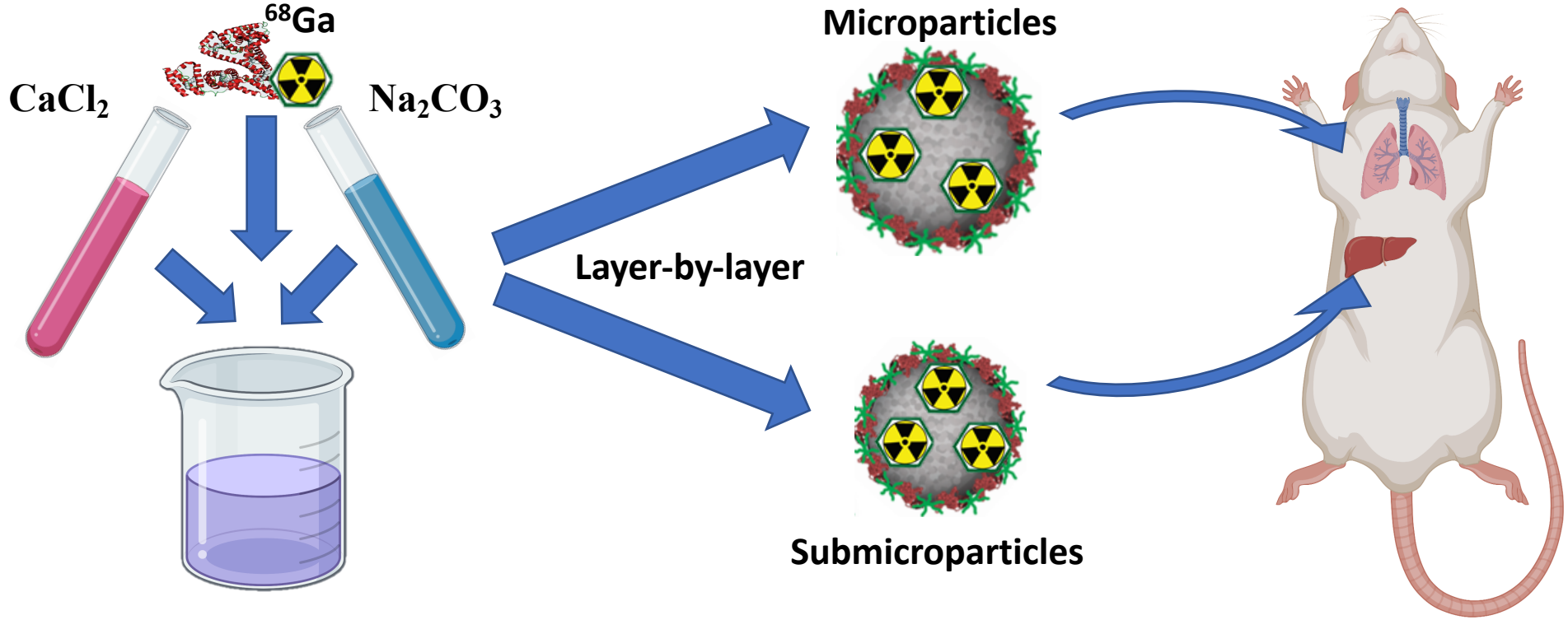
2.Russian Research Center of Radiology and Surgical Technologies named after A. M. Granov (RRCRST) of Ministry of Public Health
3.Nanobiotechnology Laboratory, St. Petersburg Academic University
4.Research School of Chemical and Biomedical Engineering, National Research Tomsk Polytechnic University



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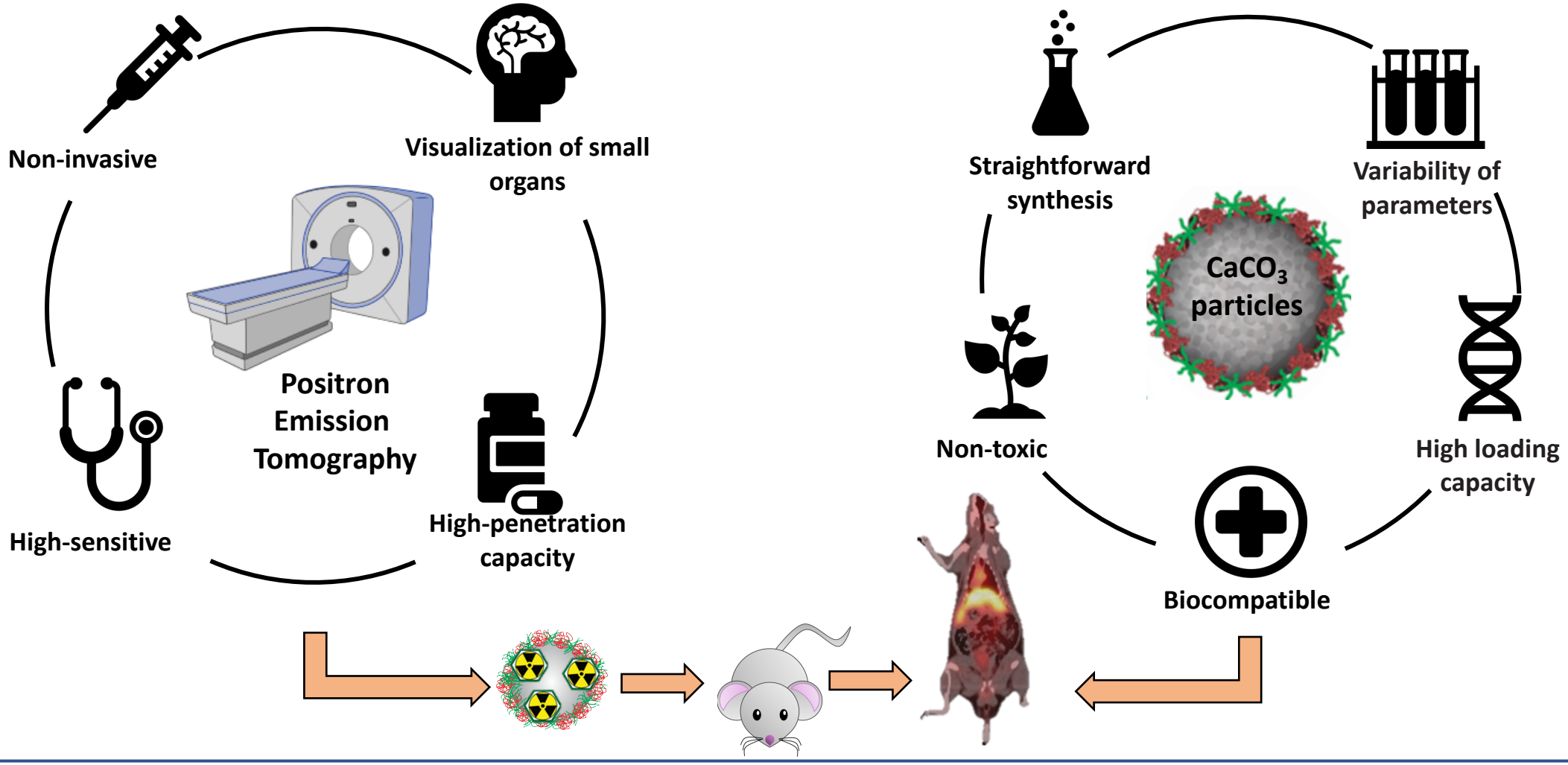

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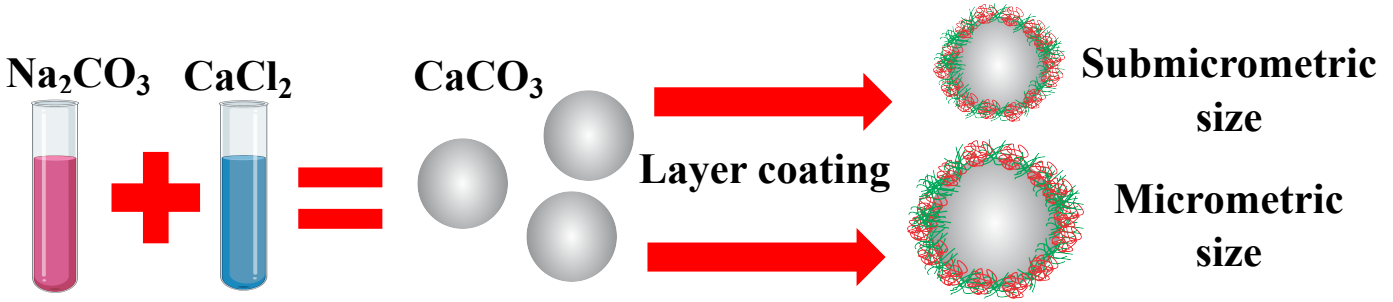
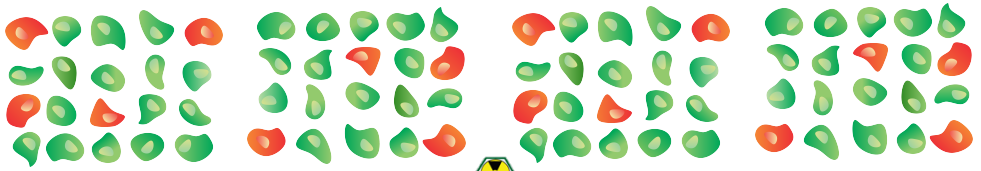
The main goal: to develop different radiolabeling approaches of micrometric and submicrometric core-shell $CaCO_3$ particles for an effective in vivo PET imaging.

Tasks:

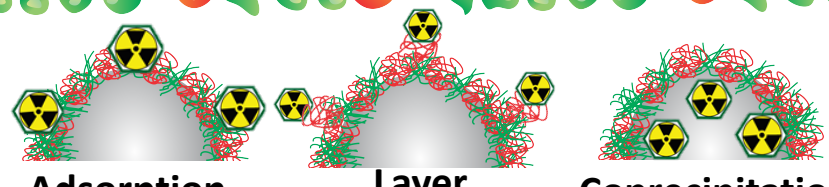
1. Particles synthesis and characterization



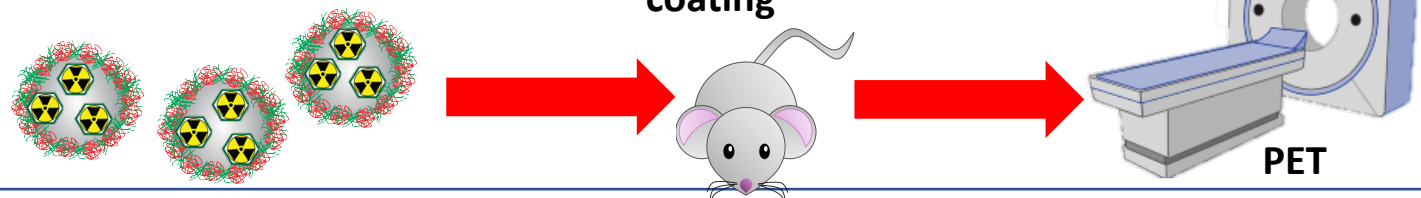
2. Toxicity studies



3. Radiolabeling strategies



4. *In vivo* visualization



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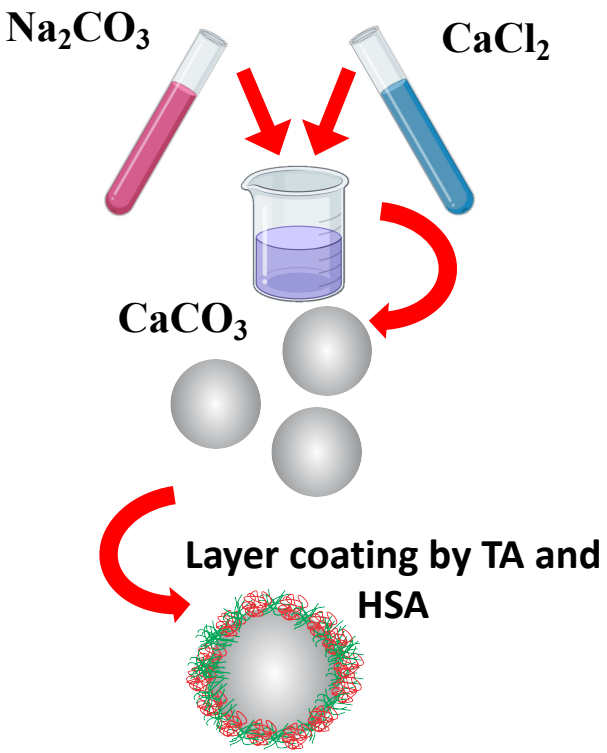
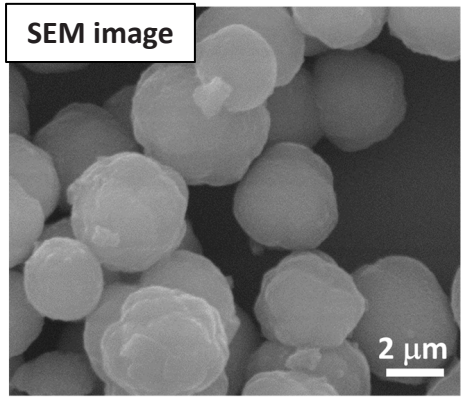
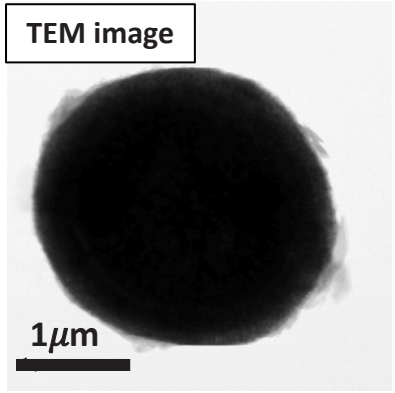
Particle synthesis

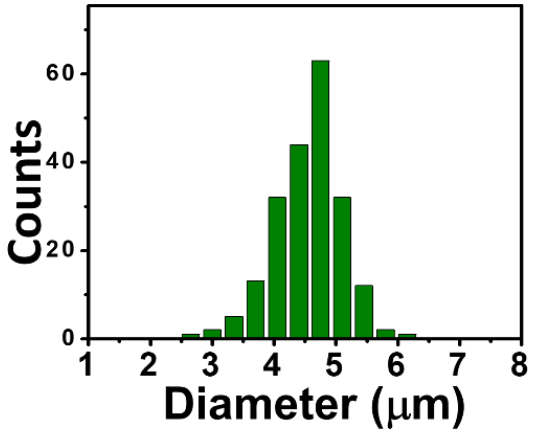


TA – Tannic Acid
HSA – Human Serum Albumin

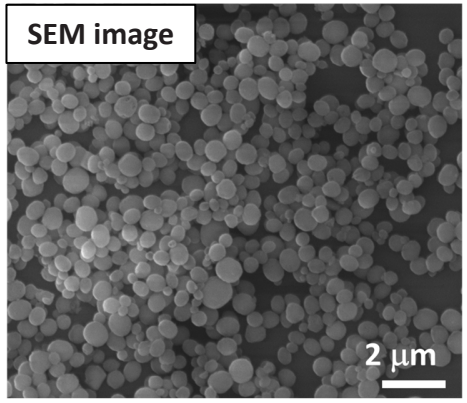
Characterization of micrometric $CaCO_3$ particles

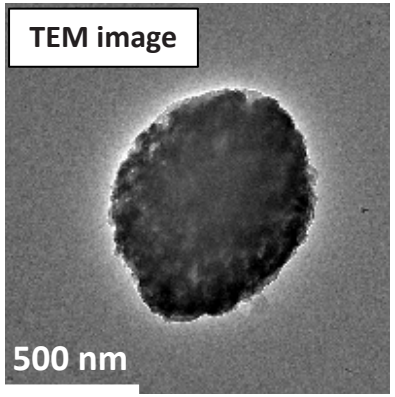


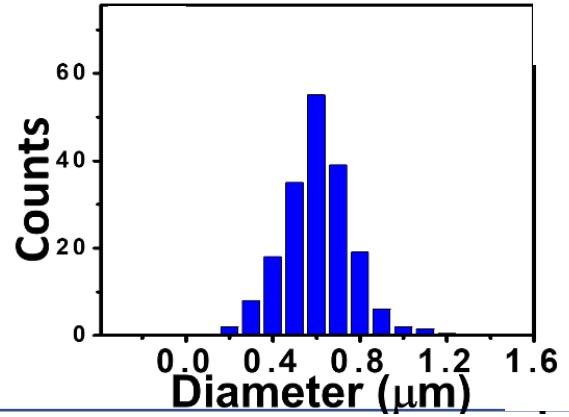




Characterization of submicrometric $CaCO_3$ particles







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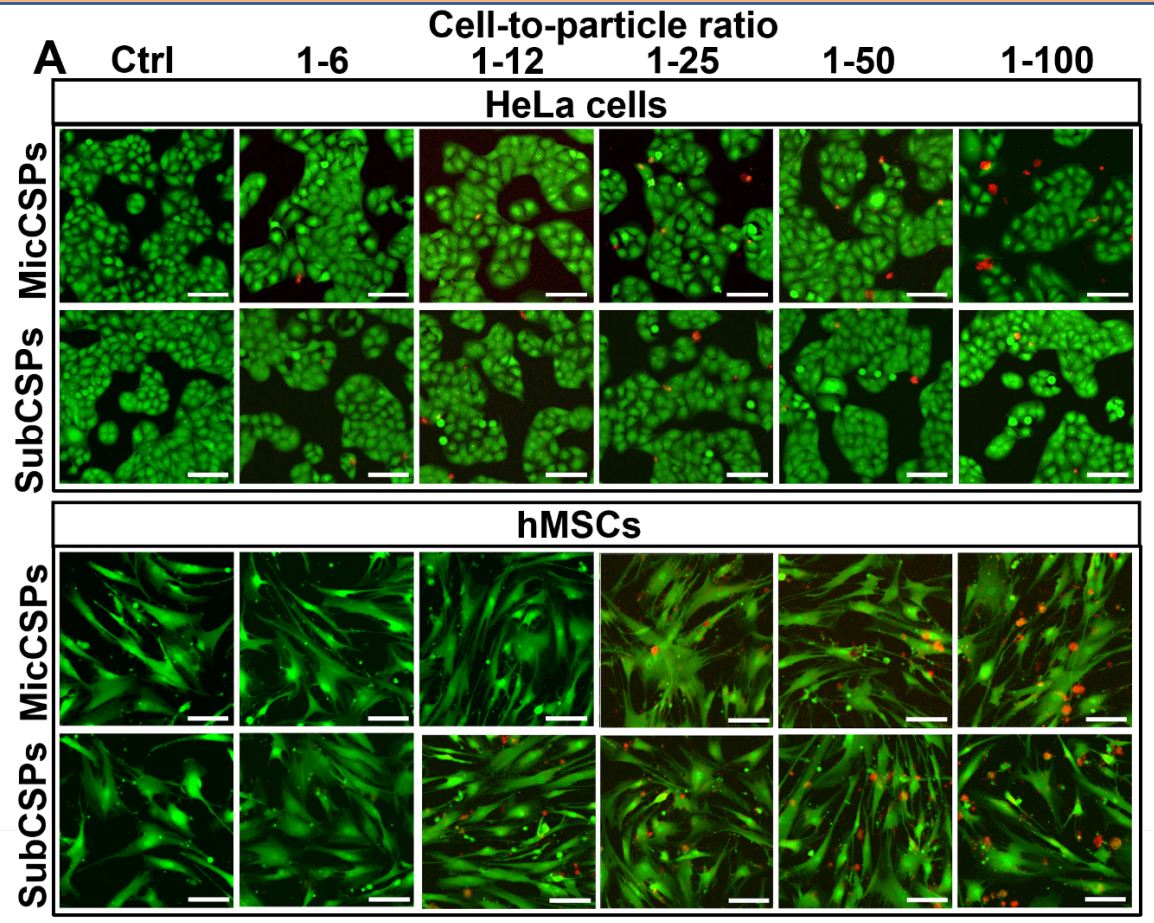
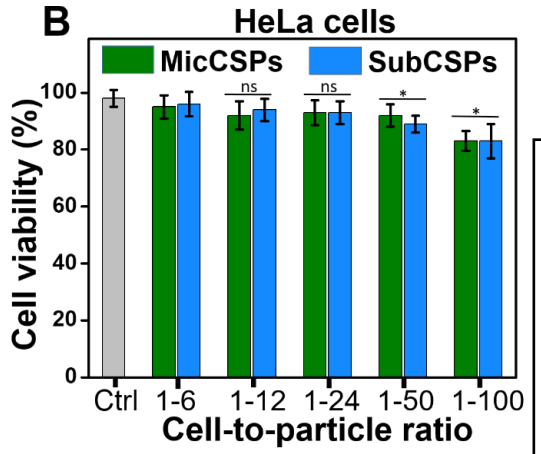
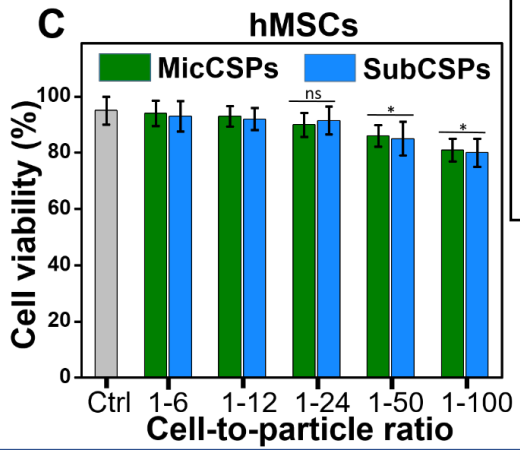
Live/dead assay after 24 h incubation with particles



Cells viability after 24h incubation with particles





– MicCSPs - Microparticles

– SubCSPs –Submicroparticles

Living cells were stained with Calcein AM (green)

Dead cells were stained with propidium iodide (red).

HeLa cells – model of cancerous cells

hMSCs - Human mesenchymal steam cells

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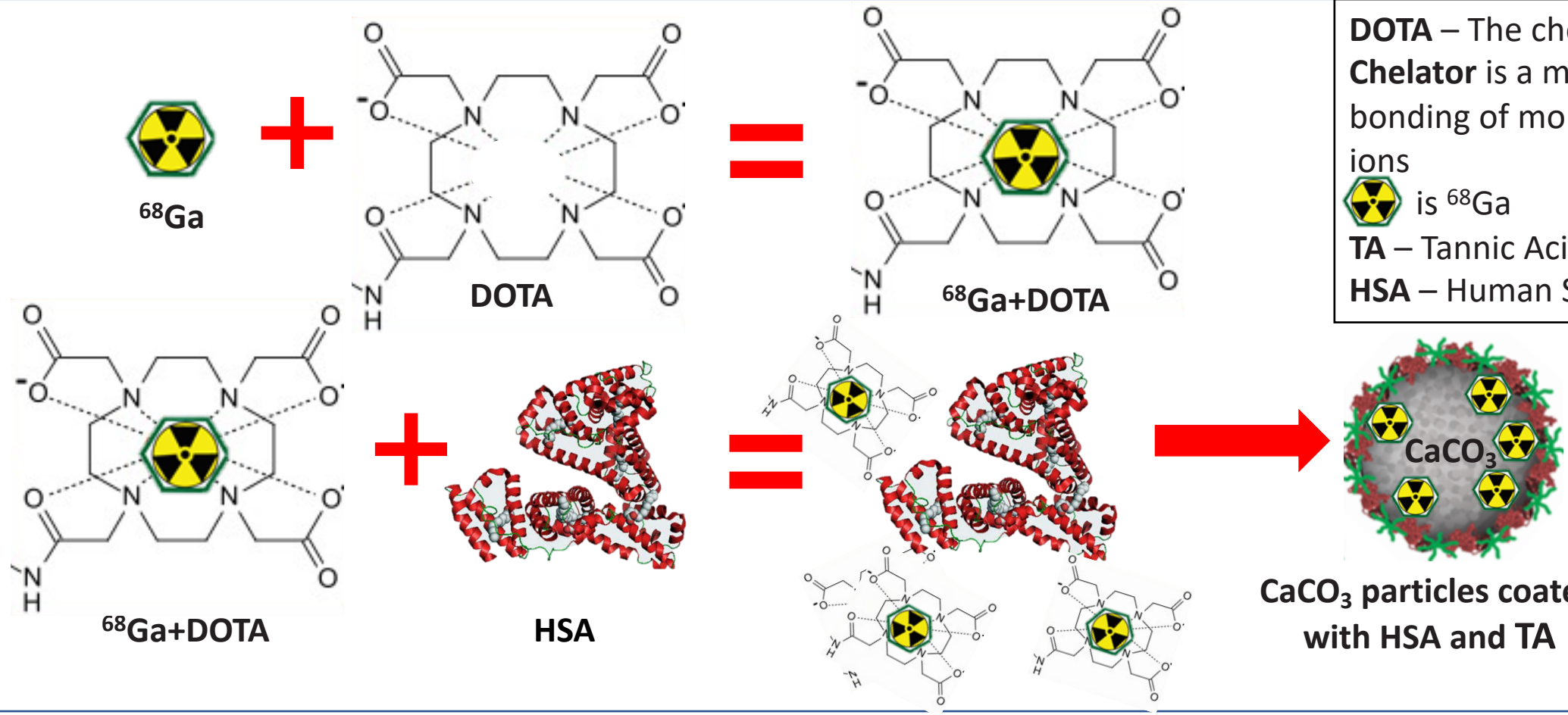
^{68}Ga encapsulation strategies



DOTA – The chelator molecule
Chelator is a molecule for bonding of molecules to metal ions
is ^{68}Ga
TA – Tannic Acid
HSA – Human Serum Albumin

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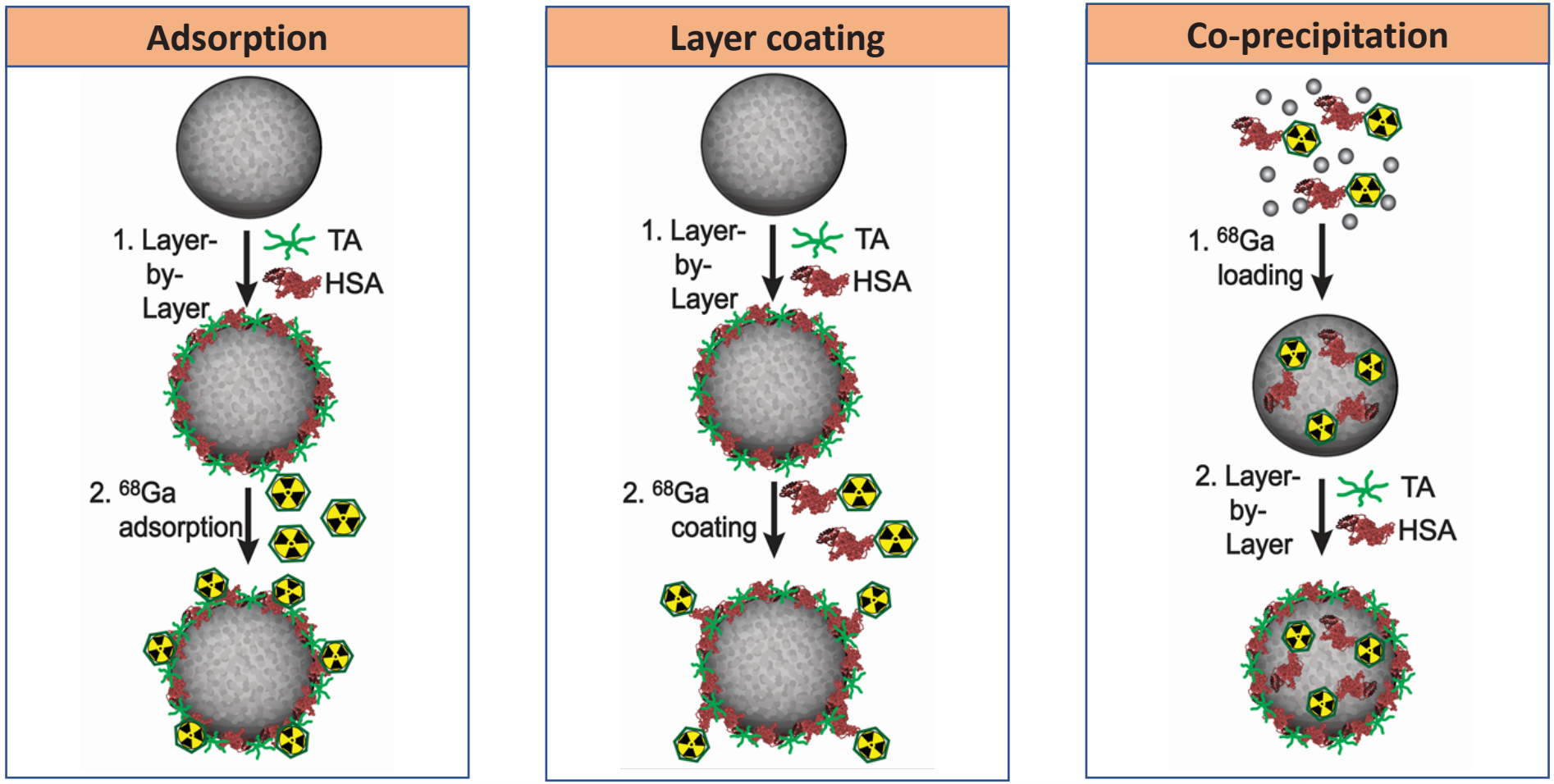

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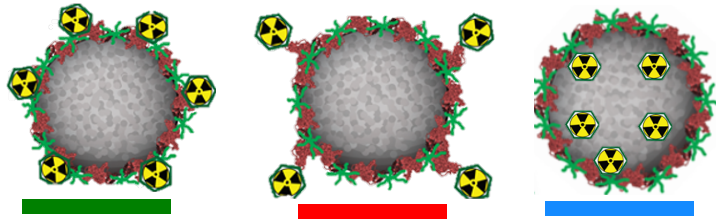
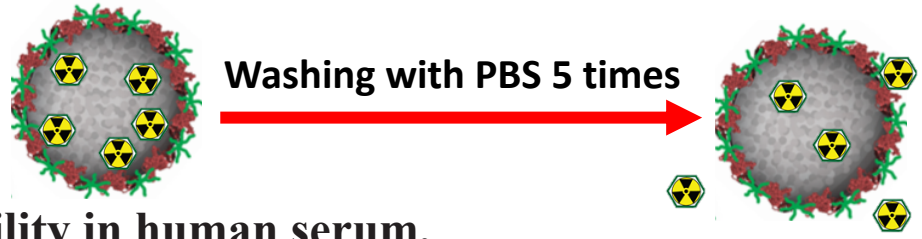
The efficiency of the encapsulation

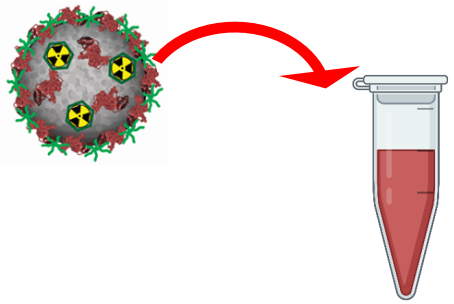
A. Bounding efficiency of ^{68}Ga-DOTA-HSA and ^{68}Ga-DOTA with particles

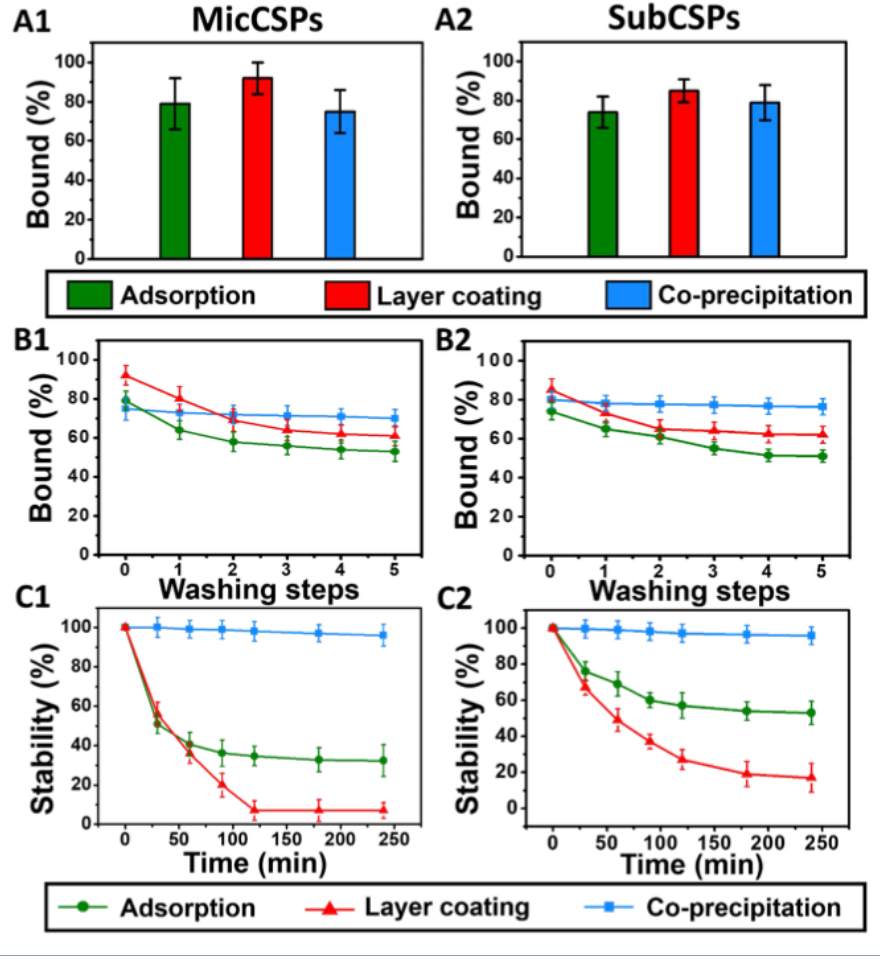


B. Retention efficiency of ^{68}Ga-DOTA-HSA and ^{68}Ga-DOTA within particles



***C. In vitro* stability in human serum.**





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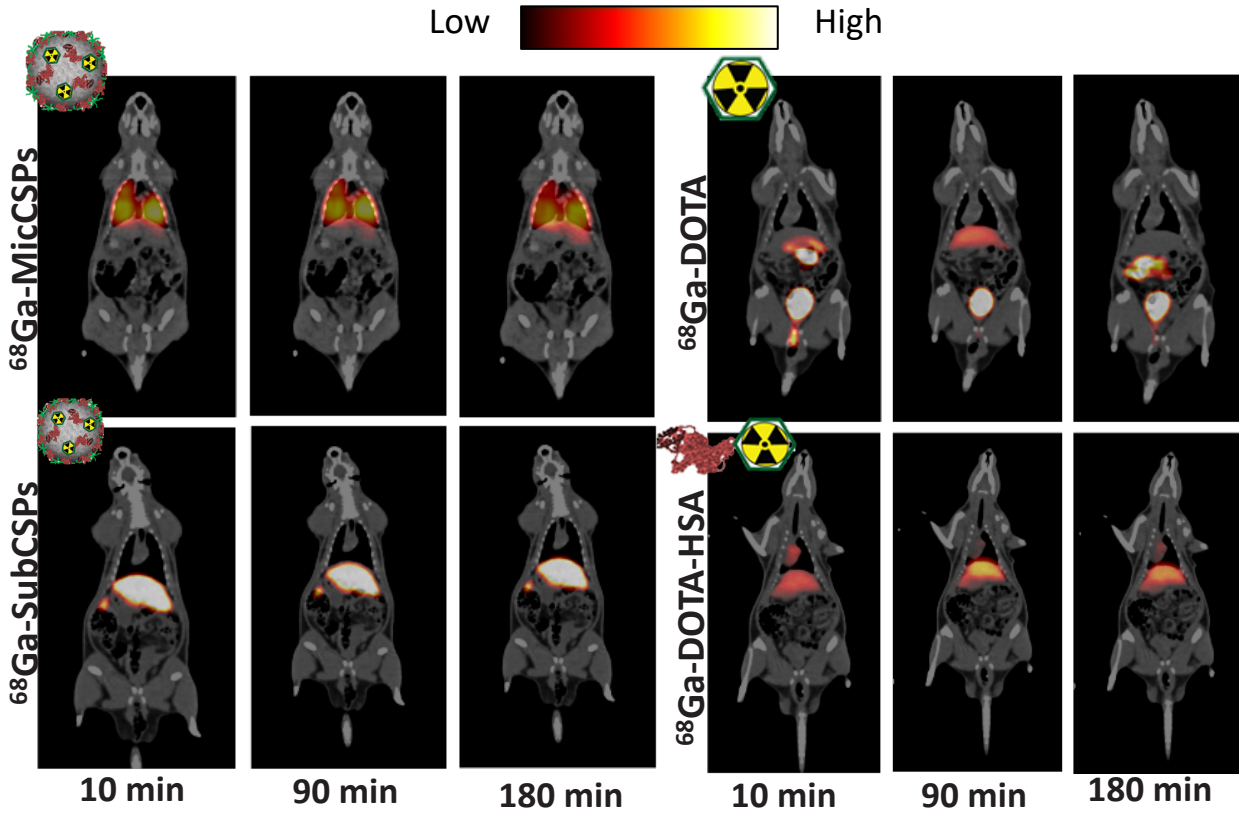
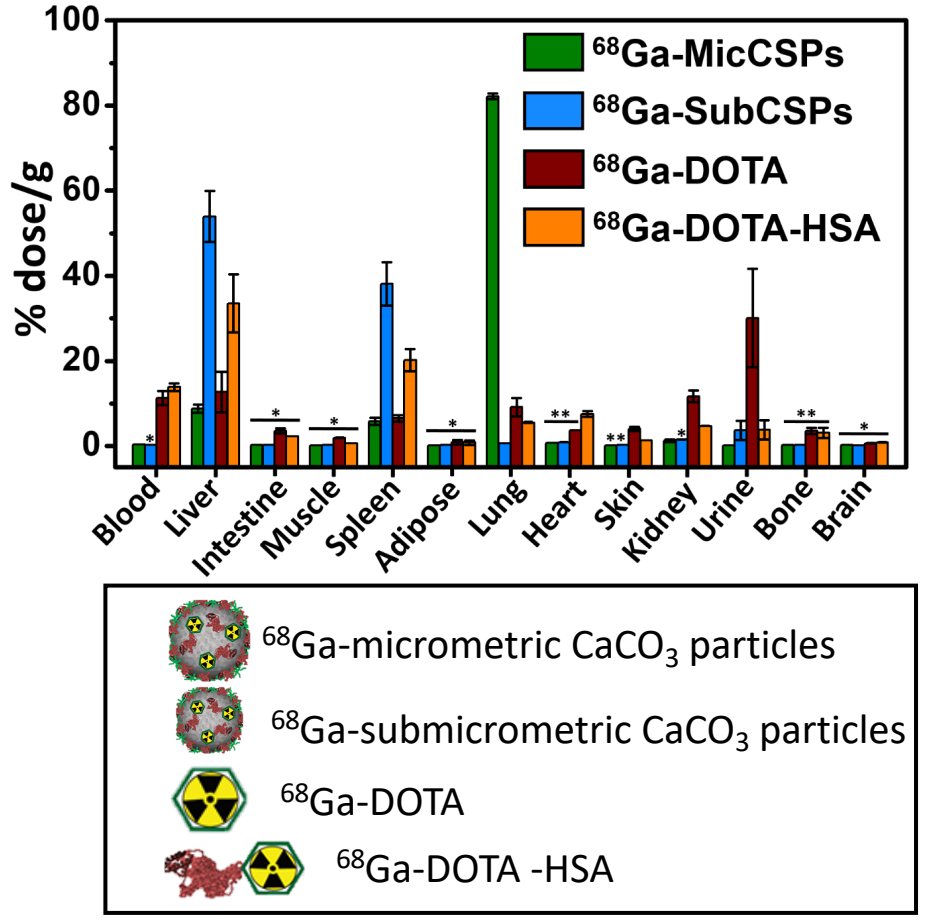
PET/CT images at different time points



The biodistribution profile by radiometric analysis



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Results

1. Different radiolabeling strategies of $CaCO_3$ particles were developed: adsorption, layer coating and co-precipitation.
2. Among the tested encapsulation methods, coprecipitation loading strategy is the most efficient (in the order of retention efficiency and *in vitro* stability) strategy to load ^{68}Ga.
3. *In vivo* experiments on rats reveled passive accumulation ^{68}Ga-Micrometric particles in the lungs; ^{68}Ga-Submicrometric particles were accumulated in the liver and spleen.

Conferences and publications

1. M. V. Zyuzin, E. N. Gerasimova et al. Radiolabeling strategies of micron- and submicron sized core-shell carriers for in vivo studies. ACS Appl. Mater. Interfaces, 2020, DOI:10.1021/acsami.0c06996
2. Elena N. Gerasimova, “Delivery of radionuclides using biocompatible calcium carbonate particles.”, ITMO Open Science 2020, poster

Contact: elena.gerasimova@metalab.ifmo.ru