Self-Assembled Bio-reducible Hybrid Supraparticles

F. Baldelli Bombelli[*1], D. Maiolo[1], C. Pigliacelli[1,2], P. Sanchez Moreno[1], I. Tirotta[1], P. Metrangolo[1-3]

[1]*Fondazione Centro Europeo Nanomedicina@NFMLab, Department of Chemistry, Materials, and Chemical Engineering "Giulio Natta", Politecnico di Milano, Via L. Mancinelli 7, 20131 Milan, Italy.*

[2]*HYBER Centre of Excellence, Department of Applied Physics, Aalto University, 02150 Espoo, Finland.*

[3]*VTT-Technical Research Center of Finland Ltd, Biologinkuja 7, 02150 Espoo, Finland.*

[*]*francesca.baldelli@polimi.it*

In last decades research in the field of nanomedicine received an incredible boost due to the development of nanostructures combining diagnostic and therapeutic abilities in one single object, i.e. theranostic nanoparticles (NPs). However, the potential clinical application of theranostic NPs is often hampered by the complex chemistry involved in their synthesis as well as their low rate of accumulation in the region of interest (ROI) by systemic administration.

Self-assembly of small NPs into supraparticles (SP) represents a promising approach to overcome these issues allowing a simplified synthetic procedure, which blends more NPs in one single nano-object able to deliver a higher number of NPs to the ROI.

In this contribution, we present the development of bio-reducible protein stabilized SPs composed of small Au-NPs capped with different organic ligands, which could also be loaded with hydrophobic drugs. The assembled SPs were stable in physiological conditions for months and were endowed with antifouling properties and an appreciable tumoritropic fate. In particular, in vitro studies showed that once these SPs entered the cell, their protein shell was progressively dismantled enabling a controlled release of their cargo. Thus, the assembly of NPs into SPs allowed simultaneous delivery of high Au-NP contents (providing nearly three times greater X-ray attenuation per unit weight than iodine) and drugs to the ROI. Overall, we think that these newly developed SPs represent a promising innovative theranostic system.

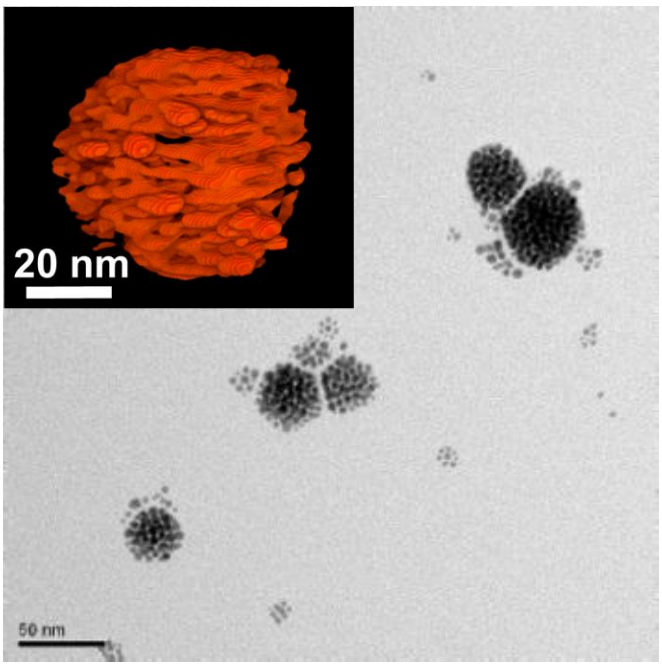

Figure 1: Cryo-TEM images of water solutions of Au-NPs assembled in SPs stabilised by a hydrophobin shell (in the inset is reported the tomography of a SP). Bar 50 nm in the figure and 20 nm in the inset.