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Green and bioinspired nanoparticles for nanomedicine applications

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In recent decades, the role of bioinspired hybrid nanoparticles synthesis and application in the filed of nanomedicine has attracted great attention. In this talk we will present two classes of nanomaterials with different physical chemical characteristics that would be very promising for the development of nanodrugs against cancer, aging and inflammation. Inspired by the biosilica morphogenesis, which takes place inside the diatom cell within the silica deposition vescicle, we set up a biomimetic/bioinspired design and synthesis of structural and functional hybrid organic/inorganic SiO2-based nanostructures, which present many distinctive advantages over traditional chemical synthesis methods. The intriguing ability of diatom long chain polyamines to rapidly induce precipitation of SiO2 spheres has motivated the in vitro one-pot synthesis of SiO2 particles. Therefore, the templating by amine-bearing molecules is seen as a successful biomimetic approach for the synthesis of SiO2-based hybrids under mild and environmentally friendly conditions for biosensing and biomedical applications [1]. Moreover, we recently developed a new one-pot green synthetic route, by using leaves extract of Laurus nobilis, to obtain monodispersed ultrasmall SiO2 NPs without the use of dangerous chemicals [2]. By means of morphomechanical studies we demonstrated that the green SiO2 NPs compromised cells to a lesser extent than the other SiO2 NPs types, thus confirming that there is a link between the cell elasticity and the physicochemical properties of NPs [3]. The gold nanoparticles-based cancer therapy is at the centre of many debates. Their physical-chemical properties are suitable to induce thermal stress in tissues, making them powerful tools to selectively kill cancer cells. However, the synthetic route residuals and the capping agents used to obtain gold NPs, often induce the strong activation of macrophages inflammatory response, limiting their further applications in the human body. We developed a simple green method to obtain stable and spherical small gold nanoparticles capped with polyphenols. The polyphenols shelled NPs were used in macrophages cell line to test key inflammation-related markers. We prove the potential of polyphenols shelled NPs to strongly promote the inflammation shutdown, making them as heat synergists in the thermal treatment of breast cancer cells. Our results demonstrate that the combined strategy markedly exerts the anticancer effect against the breast cancer cells, while none of the single treatment induced such changes [4,5].

Recent publications:

1. Della Rosa, G., Di Corato, R., et al. (2020). “Tailoring of silica-based nanoporou s pod by spermidine multi-activity.” Sci Rep 10, 21142 2. Valeria De Matteis, Mariafrancesca Cascione, Agnese De Luca, Daniela Erminia Manno, Rosaria Rinaldi. 2022. "High Doses of Silica Nanoparticles Obtained by Microemulsion and Green Routes Compromise Human Alveolar Cells Morphology and Stiffness Differently", Bioinorganic Chemistry and Applications, vol. 2022, Ar ticle ID 2343167, 23 pages, 2022.

3. Cascione, Mariafrancesca, Valeria De Matteis, Giacomo Mandriota, Stefano Lep oratti, and Rosaria Rinaldi. 2019. "Acute Cytotoxic Effects on Morphology and M echanical Behavior in MCF-7 Induced by TiO2NPs Exposure" International Journal of Molecular Sciences 20, no. 14: 3594.

4. De Matteis, Valeria, Mariafrancesca Cascione, Loris Rizzello, Daniela Erminia Ma nno, Claudia Di Guglielmo, and Rosaria Rinaldi. 2021. "Synergistic Effect Induce d by Gold Nanoparticles with Polyphenols Shell during Thermal Therapy: Macroph age Inflammatory Response and Cancer Cell Death Assessment" Cancers 13, no. 14: 3610.

5. De Matteis, Valeria, Loris Rizzello, Mariafrancesca Cascione, Eva Liatsi-Douvitsa, Azzurra Apriceno, and Rosaria Rinaldi. 2020. "Green Plasmonic Nanoparticles an d Bio-Inspired Stimuli-Responsive Vesicles in Cancer Therapy Aplication" Nanom aterials 10, no. 6: 1083

Biography

Rosaria Rinaldi is currently Full Professor of Condensed Matter Physics at the Dept. of Mathematics and Physics of University of Salento, and she is a member of the Academic University Senate. Since 2019 she is Member of the Ministry of University and Research (MUR) Evaluation Committee for Strategic Projects to be implemented by public research institutions. Prof. Rinaldi is currently in charge of the research center in "Nanomedicine, Nanobioelectronics and Nanobiotechnology", at University of Salento. In 2005 she was awarded the medal of "Le Scienze" and the medal of the President of the Republic for research carried out in the field of Nanobiotechnology. She was head of the Natural Sciences Department of and vice-director of University excellence school ISUFI till 2020. She won the "ITWIIN-High Education" award in 2016) She has been coordinating more than 30 scientific projects at regional, national and EU level, in the last 15 years. R.R. is author and co-author of about 330 papers published in international scientific journals,13 monographs and book chapters, and 12 patents (H-index:46).

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