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seminar

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Host: Dr. Maurizio Prato

Functional nanomaterials from diatoms microalgae

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Diatoms are a prolific class of single cell algae living in both fresh and marine water ecosystems, which are characterized by having their cells encased in three-dimensional amorphous nanostructured silica shells (frustules).

From the perspective of a synthetic chemist, the silica shells of diatoms can be envisaged as a plentiful source of micro/nano structures useful to build up smart functional nanomaterials for photonics, electronics and biomedicine [1].

Differently from the industrial production of silica, the biosynthesis of natural SiO_2 occurs in mild conditions and in the absence of toxic reagents. Frustules exhibit interesting properties such as high surface area, mechanical resistance and nanotexturization. In addition, frustules' biosilica can be easily chemically modified to add new functions. This can be done by simple surface functionalization and/or *in vivo* by adding specific molecules to the culture medium.

We have demonstrated the production of photonic microstructures by *in vivo* incorporation of tailored light emitting molecules in living *Thalassiosira weissflogii* diatoms [2]. With a similar approach, biosilica has been doped with phosphorescent Iridium complexes [3]. We have also reported applications of chemically modified frustules for bone cells growth [4]. More recently, we started to investigate the production of functional structures by coating living diatoms with biomimetic polymers like polydopamine (PDA). The resulting hybrids turn out to be intriguing platforms for additional chemical modifications such as, for example, surface coverage with metal nanoparticles [5] or with several classes of enzymes.

Overall, our studies point out new concepts in the synthesis of nanomaterials by combining biotechnological production of microalgae and the tools of organic synthesis.

[1] Ragni, R. , Cicco, S.R., Vona, D., Farinola, G.M. *Adv. Mater.* **2018** 1704289,1-23.
[2] Ragni, R., Scotognella, F., Vona, D., Moretti, L., Altamura, E., Ceccone, G., Mehn, D., Cicco, S.R., Palumbo, F., Lanzani, G. and Farinola, G.M. *Adv. Funct. Mater.* **2018** 1706214, 1–9.
[3] Della Rosa G., Vona D., Aloisi A. , Ragni R., Di Corato R., Lo Presti M., Cicco S.R., Altamura E., Taurino A., Catalano M., Farinola G.M., Rinaldi R. *ACS Sustainable Chem. Eng.* **2019**, *7*, 2207.
[4] Cicco, S.R., Vona, D., Leone, G. De Giglio, E., Bonifacio M.A. Cometa, S., Fiore, S., Palumbo, F., Ragni, R. and Farinola, G.M. *Mat Sci Eng C-Mater* **2019**, *104*, 109897
[5] Vona, D., Cicco, S.R., Ragni, R., Leone, G., Lo Presti, M. and Farinola, G.M., *MRS Commun.* **2018**, *8*, 911.