Synthesis and Applications of Self-assembled Silica Nanoparticles based Bio-hybrid Materials

Archana Mishra[ab] and Jose Savio Melo[ab]

[a]Nuclear Agriculture and Biotechnology Division, Bhabha Atomic Research Centre, Trombay, Mumbai, India
[b]Homi Bhabha National Institute, Anushakti Nagar, Mumbai-400 094, India

Keywords: Silica nanoparticles; Bio-hybrids; Biological components; Microorganisms; Biosensor; Drug delivery.

Abstract (300 word limit)

In recent years, colloidal silica has gained popularity in materials science as nano- and microparticle due to its unique properties like high surface area, high colloidal stability, low toxicity, biocompatibility, well known surface chemistry, optical transparency and chemical and thermal stability [1]. On the other hand, for the efficient application of silica there is need to functionalization and chemical route of functionalization is a multi-step and costly process.

To address the issue, we came up with the idea to synthesize bio-hybrids (a combination of biological component and inorganic nanoparticles). Biological component acts as functional unit and inorganic component acts as structural unit in the bio-hybrid (Fig. 1). Different bio-components were associated with silica nanoparticles and bio-hybrids were synthesized. Bio-hybrid materials exhibit dual functionality like hybrid materials which comes from inorganic and biological components. Associations of biological components with silica nanoparticles have opened a window of interest because of their immense potential applications. Developed bio-hybrids can be applied for different applications such as biocatalysis [2,3], biosensing [1], remediation [4,5] and drug delivery. This integration of silica nanoparticles with bio-component will no doubt lead to new functional materials, improved sensing materials and new drug delivery vehicles which will have far-reaching impact in biotechnology.

Image

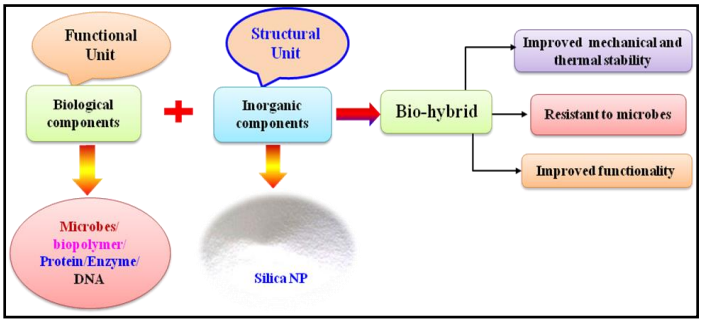


Fig 1: Bio-hybrid materials and its components.

References

1. A. Mishra, J. Kumar, J. S. Melo (2017) An optical microplate biosensor for the detection of methyl parathion pesticide using a bio-hybrid of *Sphingomonas sp.* cells-silica nanoparticles, Biosens. Bioelectron. 87:332–338.
2. A. Mishra, J. S. Melo, A. Agrawal, Y. Kashyap, D. Sen (2020) Preparation and application of silica nanoparticles-*Ocimum basilicum* seeds bio-hybrid for the efficient immobilization of invertase enzyme, Colloids Surface B. 188:110796.
3. S. Mukundan, J.S. Melo, D. Sen, J. Bahadur, (2020) Enhancement in β-galactosidase activity of *Streptococcus lactis* cells by entrapping in microcapsules comprising of correlated silica nanoparticles, Colloids Surface B 195:111245.
4. A. Mishra, J. S. Melo, D. Sen, S. F. D'Souza (2014) Evaporation induced self assembled microstructures of silica nanoparticles and *Streptococcus lactis* cells as sorbent for uranium (VI), J. Colloid Interface Sci. 414:33-40.
5. P. Shukla, A. Mishra, S. Manivannan, J.S. Melo, D. Mandal (2020) Parametric optimization for adsorption of mercury (II) using self assembled bio-hybrid J. Environ. Chem. Eng. 8:103725.



Biography (150 word limit)

Dr. Archana Mishra is currently Scientific Officer E in Bioscience Group, Bhabha Atomic Research Centre, Mumbai, India. She obtained her M. Sc. Biotechnology Degree from Banaras Hindu University, India in 2009 and received her Ph.D. from Homi Bhabha National Institute, Mumbai India in Life Sciences. Her research is focused in the area of development of novel silica based biohybrid materials, nanomaterials, hybrid materials and their further applications in biosensor, environmental biotechnology, bioprocess development and drug delivery. Dr. Mishra has published high quality international peer-reviewed articles, reviews, book chapters and has developed technology in her area of research.

Email: archanamishra56@gmail.com; archanam@barc.gov.in