Comparing Antifouling Strategies on Silica Nanoparticles

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Protein adsorption onto nanoparticles immersed in biological fluids alters fundamental surface properties and ultimately modifies the interaction of nanomaterials with biological systems.¹ Thus, finding antifouling strategies has been an active subfield of research within nanomedicine since its very origin.² In this context, developing theoretical tools for rapid screening of potential antifouling candidates is of paramount importance.

In this work, we present a theoretical study of various antifouling strategies to prevent protein adsorption on silica nanoparticles using a molecular theory approach.³ We evaluated surface modifications with short zwitterions, with PEG and with mixed silanes (producing pseudo zwitterionic surfaces) against the adsorption of lysozyme. This cationic protein is strongly adsorbed onto negatively born surfaces and represents a big challenge for antifouling coatings.⁴ The influence of grafting density, remnant non-reacted silica silanols, and media pH and ionic strength was assessed to understand the mechanism underlying the prevention of protein adsorption provided by the above mentioned functionalizations. Theoretical results were compared with experimental characterizations using DLS, SAXS, ITC and UV-Vis spectroscopy.