

Surface Imprinting Approach for the Design of Virus Recognition Nanoparticles

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The presence of pathogenic viruses in various fields including environment, agro-food and pharmaceutical industries is an issue for human health. The development of virus recognition materials remains an unsolved challenge. Molecular imprinting allows the creation of polymers (molecularly imprinted polymers, MIPs) possessing artificial binding sites for a target molecule through a template assisted polymerization of specific monomers.¹ Despite the achievements in molecular imprinting of low molecular weight targets, macromolecular imprinting of large templates, i.e. viruses, remains underdeveloped. Mainly because of the viruses fragile self-assembled nature and their relatively large size which is limiting their diffusion into the imprinted polymer.² Our results pave the way for a new approach that tackles the main issues in the design of virus-recognition nanomaterials. Our method for the synthesis of the virus imprinted particles (VIPs), entirely performed in water, includes: (a) the covalent anchoring of viral particles at the surface silica nanoparticles (SNPs); (b) the surface initiated growth of a thin organosilica layer (<20 nm, named recognition layer); (c) the removal of the viral particles.³ The newly developed method allowed, for the first time, to design and produce virus surface-imprinted nanoparticles.⁴ It was demonstrated that those imprints exhibit a hexagonal profile, originating from the icosahedral morphology of the template virus. The binding performances of the VIPs, based on batch rebinding study in aqueous conditions, will be reported. The interaction assays showed that VIPs are capable of binding selectively the template virus in the pM range concentrations. In addition, it was demonstrated that the thickness of the recognition layer had a direct effect on the affinity of the VIPs for the target virus. Finally, the VIPs selective binding performance in complex matrix (human serum) will be discussed.

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