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Bio-inspired superoleophobic and smart materials: Design, fabrication, and application

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ABSTRACT

Through evolution, nature has arrived at what is optimal. Inspired by the biomaterials with special wettability, superhydrophobic materials have been well-investigated and -covered by several excellent reviews. The construction of superoleophobicity is more

Abbreviations: 3D-DLT, three-dimensional diffuser lithography technique; AAPM, aminosilane N-(2-aminoethyl)-3-aminopropyltrimethoxysilane; ACNT, aligned carbon nanotube; ALD, atomic layer deposition; ATRP, atom transfer radical polymerization; Au-NPs, gold nanoparticles; BMG, bulk metallic glass; CVD, chemical vapor deposition; DLC–PDMS-h, diamond-like carbon–polydimethylsiloxane hybrid; DYS, sodium dodecyl sulfate; EDOT, 3,4-ethylenedioxythiophenes; EDOP, 3,4-ethylenedioxypyrroles; EP, electrochemical polymerization; FAS, fluoroalkylsilanes; FD-POSS, fluorinated-decyl polyhedral oligomeric silsesquioxane; FDTS, fluoro-1,1,2,2-tetrahydrodecyl trichlorosilane; FOMMT, fluoromodified montmorillonite; f-PEG, perfluorinated end-capped polyethylene glycol; F-POSS, fluorinated polyhedral oligomeric silsesquioxanes; FPU, fluorine-end-capped polyurethane; FRP, free radical polymerization; LBL, layer-by-layer; FTS, perfluorodecyltrichlorosilane; LCP, liquid crystal polymer; LCST, low critical solution temperature; MMT, montmorillonite; MWCNT, multi-walled carbon nanotube; NBF*n*, 5-(perfluoro-*n*-alkyl)norbornenes; OAD, oblique angle magnetron sputtering deposition; P2VP, poly(2-vinylpyridine); PAA, poly(acrylic acid); PAM, polyacrylamide; PCL, poly(ε-caprolactone); PDDA, poly(diallyldimethylammonium chloride); PDMS, poly(dimethylsiloxane); PDMSU, diureapropyltriethoxysilane [bis(aminopropyl)-terminated polydimethylsiloxane; PEDOT, poly(3,4-ethylenedioxythiophene); PEDOP, poly(3,4-ethylenedioxypyrroles); PEMA, polyethyl methacrylate; PFO, perfluorooctanoate; PFOEMA, poly[2-(perfluorooctyl)ethyl methacrylate]; PFOTES, 1H,1H,2H,2H-perfluorooctyltriethoxysilane; PFOTMS, perfluorooctyl trimethoxysilane; PFTS (PFDTS), perfluorooctyl/perfluorodecyl trichlorosilane; PIPSMA, poly[3-(triisopropyloxysilyl)propyl methacrylate]; PMC, perfluoroalkyl methacrylic copolymer; PMMA, poly(methyl methacrylate); PNIPAAm, poly(n-isopropylacrylamide); POSS, polyhedral oligomeric silsesquioxane; PPFEMA, polymerized perfluoroalkyl ethyl methacrylate; PPP, pulsed plasma polymerization; PPy, polypyrrole; ProDOP, 3,4-propylenedioxypyrroles; PS, polystyrene; PSS, poly(sodium 4-styrene sulfonate); PTFE, poly(tetrafluoroethylene); PU, polyurethane; RF, radio frequency; SEM, scanning electron microscopy; SiNWA, silicon nanowire arrays; SI-ROMP, surface-initiated ring-opening metathesis polymerization; SIRP, surface- initiated radical-chain polymerization; SLIPS, slippery liquidinfused porous surface; SWNT, single-walled carbon nanotube; TCMS, trichloromethylsilane; TEM, transmission electron microscopy; TFD-*co*-TFE, poly[4,5-difluoro-2,2-bis(trifluoromethyl)-1,3-dioxole]-cotetrafluoroethylene; tris-TMSCl, tris(trimethylsiloxy)chlorosilane.

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difficult than that of superhydrophobicity because the surface tension of oil or other organic liquids is lower than that of water. However, superoleophobic surfaces have drawn a great deal of attention for both fundamental research and practical applications in a variety of fields. In this contribution, we focus on recent research progress in the design, fabrication, and application of bio-inspired superoleophobic and smart surfaces, including superoleophobic–superhydrophobic surfaces, oleophobic–hydrophilic surfaces, underwater superoleophobic surfaces, and smart surfaces. Although the research of bio-inspired superoleophobicity is in its infancy, it is a rapidly growing and enormously promising field. The remaining challenges and future outlook of this field are also addressed. Multifunctional integration is a inherent characteristic for biological materials. Learning from nature has long been a source of bio-inspiration for scientists and engineers. Therefore, further cross-disciplinary cooperation is essential for the construction of multifunctional advanced superoleophobic surfaces through learning the optimized biological solutions from nature. We hope this review will provide some inspirations to the researchers in the field of material science, chemistry, physics, biology, and engineering.

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