“Optically Transparent and Durable Polymer-Nanoparticle Superhydrophobic Coatings for Self-cleaning Applications”

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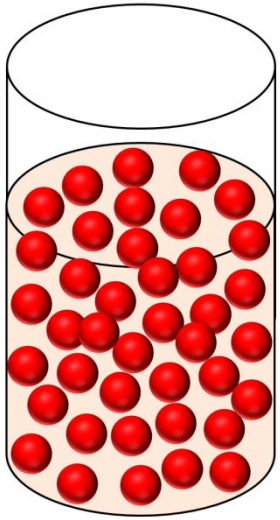
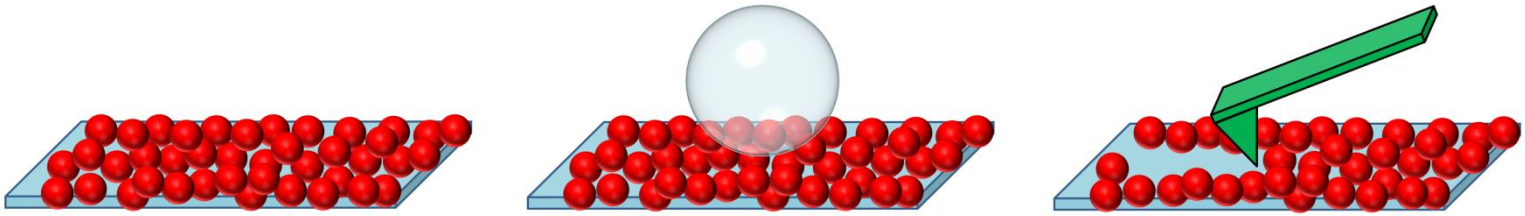


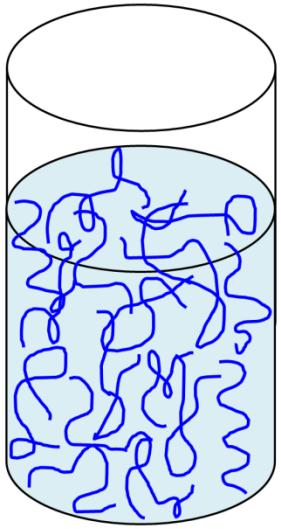
Coatings prepared by only micro/nanoparticles

Superhydrophobic

Poor scratch resistance



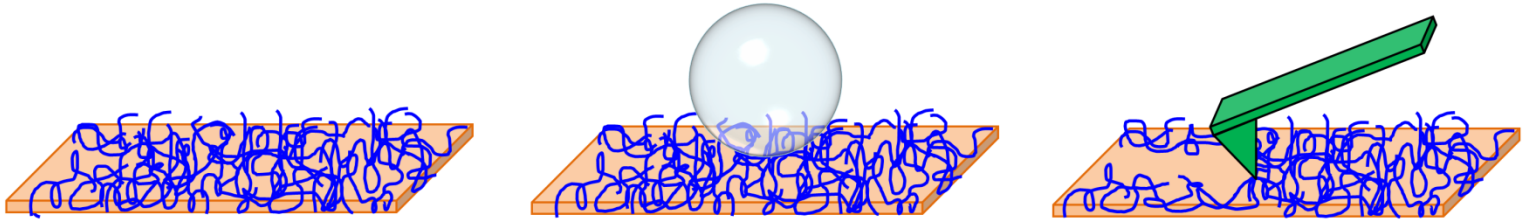
Micro/nanoparticles: Silica (SiO_2), Zinc oxide (ZnO), Titania (TiO_2), Aluminum oxide (Al_2O_3) Zirconia (ZrO_2), Cerium oxide (CeO_2), Copper oxide (CuO), **Candle Soot**, etc.



Coatings prepared by only polymers

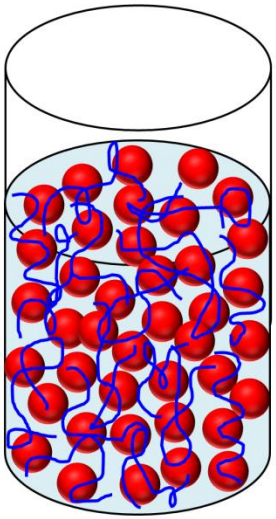
Superhydrophobic

Poor scratch resistance



Polymers: Poly(2-octyl cyanoacrylate), Polyvinylidene fluoride (PVDF), Polymethylmethacrylate (PMMA), Ethylene glycol dimethacrylate (EDMA), Polypropylene (PP), 3-(Trimethoxysilyl)propyl methacrylate, Polystyrene (PS), Polyethylene (PE), Poly(tetrafluoroethylene) (PTFE), Fluorine-end-capped polyurethane (FPU), Polydimethylsiloxane (PDMS) etc.

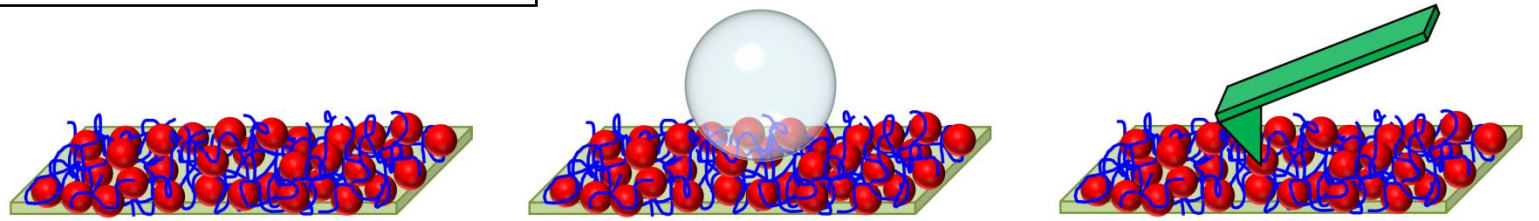
Polymer-Nanoparticle Composite System for Transparent, Adherent, and Mechanically Strong Self-cleaning Superhydrophobic Coatings



Coatings prepared by Polymer-Nanoparticle system

Superhydrophobic

Strong scratch resistance



Low loading of polymer in the nanoparticle system can improve the overall properties of the composite coating, especially the mechanical durability and optical transparency of the coatings.

Novelty of Proposed Research Work

Polymers show film-forming property, natural hydrophobicity, toughness and flexibility.

Toughness of the polymers can be very high, particularly when combined with nanoparticles.

The role of a polymer is crucial in the composite especially to add flexibility to absorb applied mechanical pressure.

Polymers are water repellent and nanoparticles provide roughness, so coatings can be Superhydrophobic.

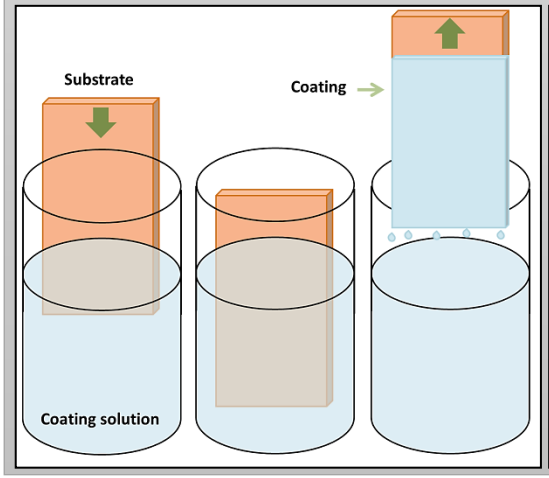
A composite can be mostly influenced by the size, shape, composition, state of agglomeration, and degree of matrix-filler adhesion as well as processing parameters.

This is an easy, one step and economical method which can provide a range of commercial products which were previously uneconomical to produce.

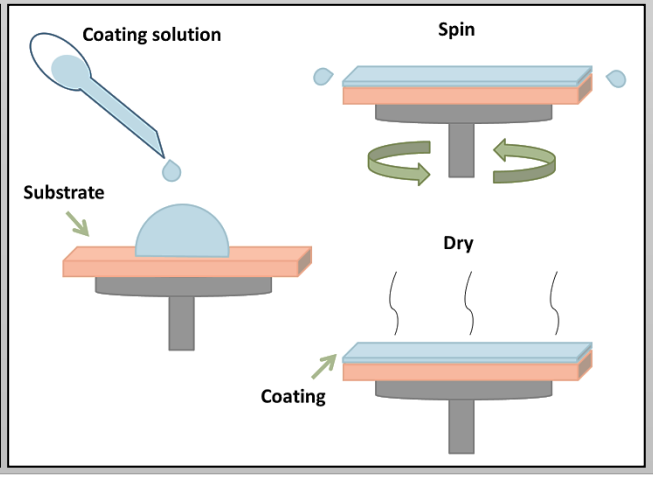
Polymethylmethacrylate (PMMA) + Suspension of Silica nanoparticles → Dip/Spin/Spray Method → Heat Treatment → Durable Water Repellent Coating

The effect of wt.% of nanoparticles, concentration and molecular weight of polymers, deposition time, number of deposition layers, deposition temperature, pH of the coating solution on the quality of the coatings will be analyzed.

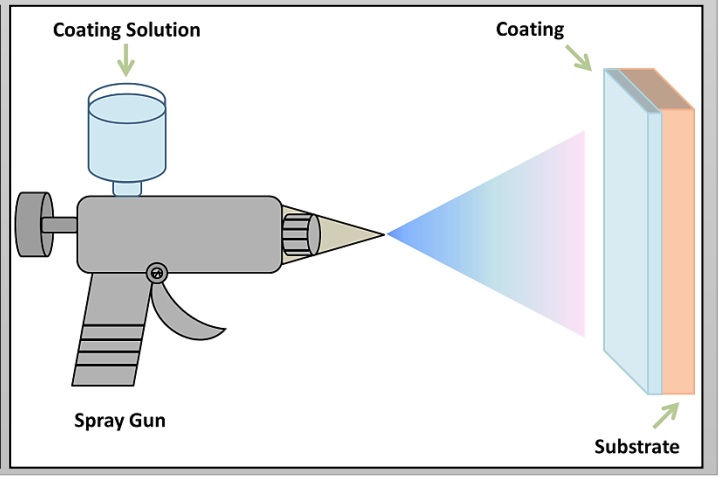
Dip Coating

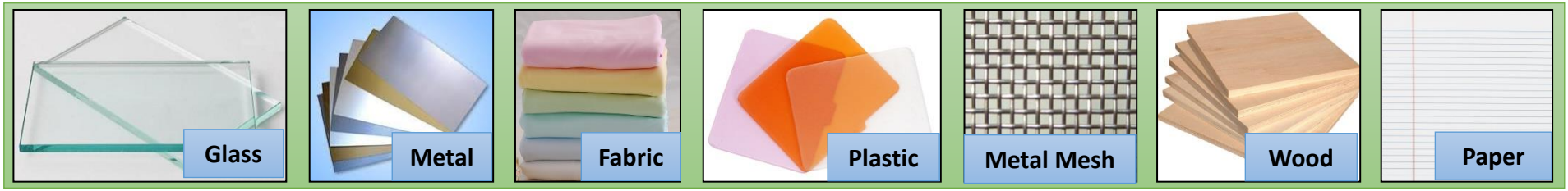


Spin Coating



Spray Coating





Industry Impact

(1) Patent generation on low-cost manufacturing process and value-adding technology.
(2) The laboratory scale studies can be modified and scaled up on an industrial scale to achieve practical products.

Economic Impact

(1) Contributing towards cheaper manufacturing.
(2) Energy , money and labor saving.

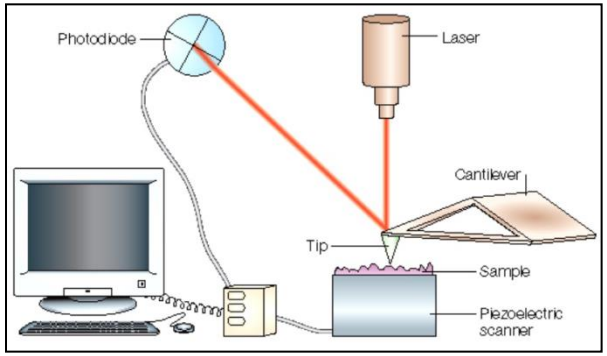
Environmental Impact

(1) Minimum pollution of environment during application.
(2) Probability of negative impacts on environment is less.

Characterization of Superhydrophobic Coatings

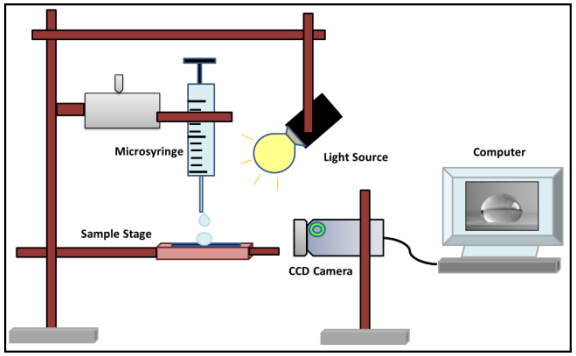
SEM

AFM

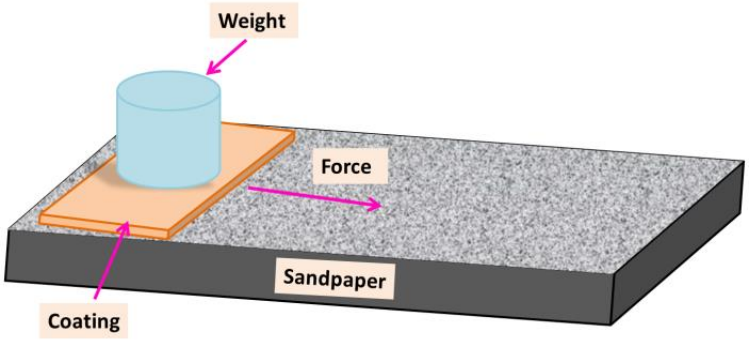


TEM

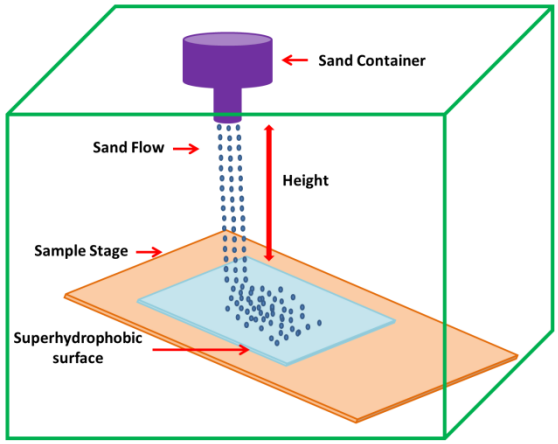
Contact Angle Measurement



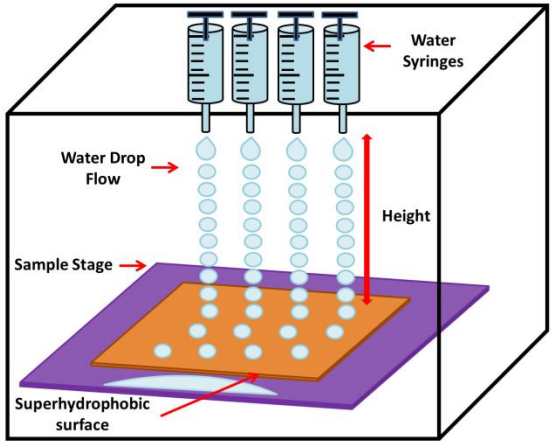
Sandpaper Abrasion Test



Sand Flow Impact Test

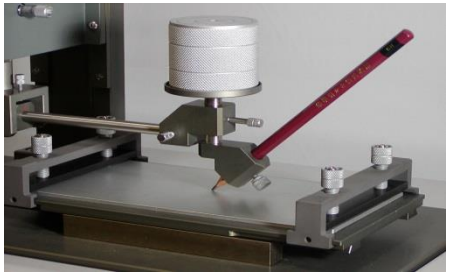


Water Drop/Jet Impact Test



- Self-cleaning properties
- Effect of acidic and basic liquids
- Scotch tape test
- Deep underwater stability
- Effect of UV light
- Anti-fouling, and anti-bacterial properties
- Anti-icing and anti-fogging properties

Pencil Hardness Test



UV-VIS Spectrophotometer

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