Aqueous Composition for Durable and Extremely Efficient Water Repelling Superhydrophobic Materials at Ambient Condition Thereof

IITM Technology Available for Licensing

Problem Statement

- Traditional superhydrophobic coating method use **harmful organic solvents & complex process**.
- Current coatings often lack **durability and performance** under varying conditions.
- **Flexibility & compatibility** in diverse substrates are essential for coatings to be widely applicable.
- Multifunctional property like **antimicrobial activity and stability** are desired.
- **Versatile coatings** capable of addressing various industry needs are crucial.
- Hence, the instant patent disclosure is in need.

Technology Category / Market

Categories: Chemistry & Chemical Analysis | Advance Material & Manufacturing

Industry: Material Science, Surface Engineering

Applications: Paints, Pigments, Paper, Varnish, Textiles, and Construction Materials.

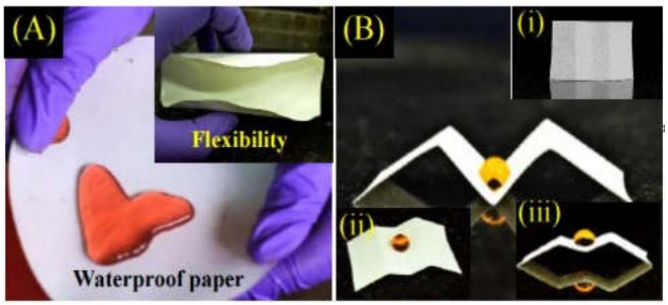
Market: The Global Superhydrophobic Coatings Market size was estimated at **$ 19 M in 2021** and will reach around **$ 120 M by 2030**, poised to grow at **25% CAGR** from **2021 to 2030.**

Technology

The instant invention discloses an **Aqueous Composition for the Durable and Extremely Efficient Water Repelling Superhydrophobic Materials at Ambient Condition Thereof.**

FIG 1A: Unstable water drops on coated filter paper shows retained mechanical flexibility

FIG 1B Induced twisting/ bending on the coated paper. Colored water drop that changes its shape to oval on folded paper due to its induced.



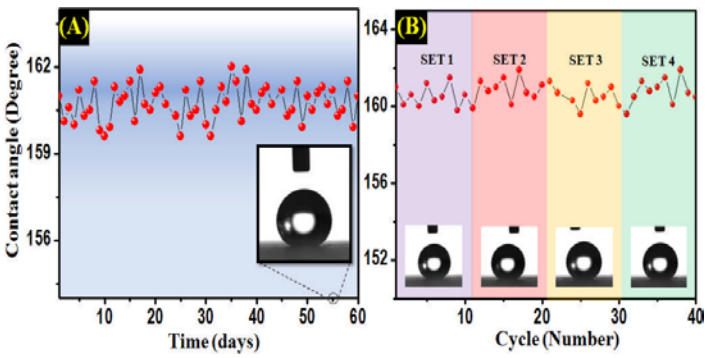


FIG 2: Durability of the coatings in **(A) ambient condition and (B) externally applied cyclic perturbations:** (Set-1) exposure to various organic fluids, (Set-2) high temperature (200 ºC) treatment (Set-3) low temperature (-80 ºC) treatment and (Set-4) exposure to direct sunlight (longevity test). Photograph showing static CA of water droplet after **(A) 55 days & (B) each set of experiments.**

Key Features / Value Proposition

User perspective:-

- **Simple** Water-based Method
- **Durable** Superhydrophobic Coatings
- **Versatile Applications**
- Reliable **Protection** Against Moisture.
- **No Need For Frequent Application**

Industrial perspective:-

- **No Organic Solvents Usage.**
- **Economically Viable Technology.**
- **Sustainable and Eco-friendly Process**
- Meets Industrial Safety & Regulatory Standards

Technology perspective:-

- Utilization of Silanes in Water-based Processes for **Chemical Modification**
- **High Contact Angles** (>160º)
- **Low Roll-off Angles** (<10º)
- Ensure Excellent Water Repellency
- Durability Against Mechanical & Chemical Stress
- **Efficient Large-scale Production**

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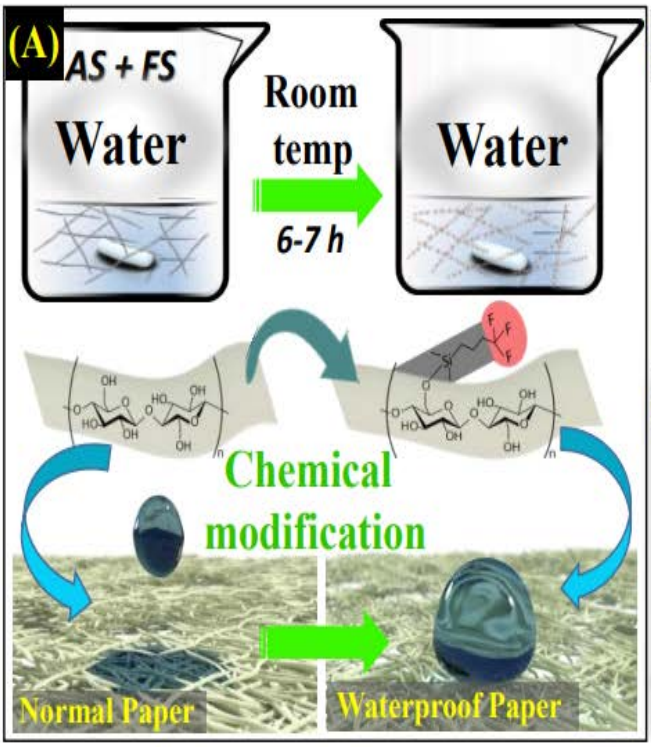
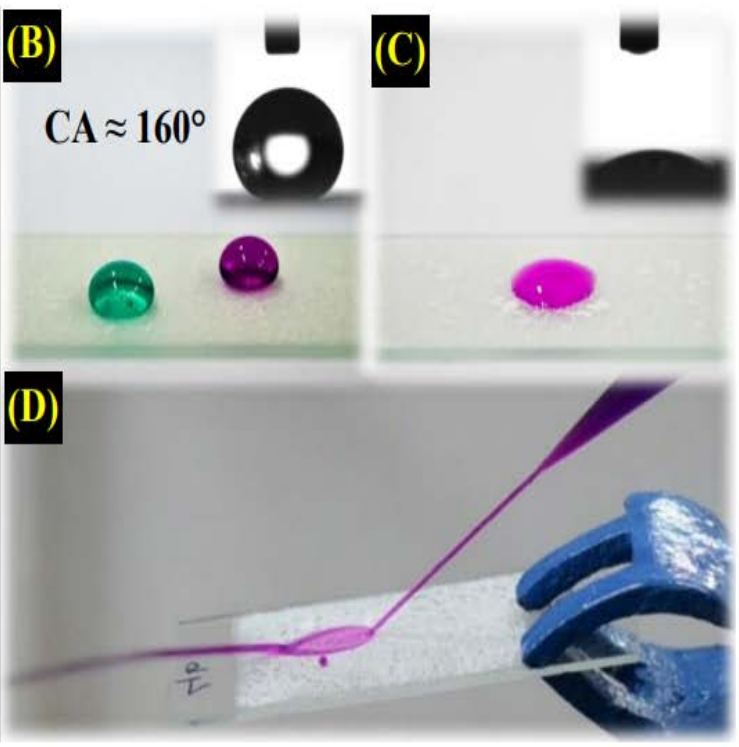
Methods Disclosed

- The disclosed methods involve the fabrication of durable & multifunctional superhydrophobic coatings using a water-based approach.
- This process eliminates the use of harmful organic solvents, making it eco-friendly.
- The method includes chemical modification and functionalization of hydrophilic materials, e.g., cellulose nanofibers or clay, using silanes.
- These materials are dispersed in water, mixed with specific functional silanes, and vigorously stirred under room temperature conditions for several hours.
- This results in formation of superhydrophobic coatings with good water-repelling properties.
- The coatings can be applied using various methods and are suitable for a wide range of substrates, including both soft & hard surfaces.
- Additionally, the coatings exhibit robustness against mechanical abrasions, thermal stability, & antimicrobial properties, making them highly versatile for diverse applications.





Intellectual Property

IITM IDF No.: **1600** | IP No.: **356023 (Granted)**

TRL (Technology Readiness Level)

TRL- 3: Proof of Concept Stage.

Research Lab

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FIG 3 (A). Schematic representation of cellulose nanofibers (CNFs) based waterborne superhydrophobic material, the building block of waterproof paper.

FIG 3 (B & C). Water droplet on modified and native CNFs coated surface. Inset, the static CA of water droplet.

FIG 3 (D). Continuous jet flow on coated glass. KMnO4 and NiSO4 aqueous solutions were used in B, C and D, respectively, instead of pure water to have color contrast.

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