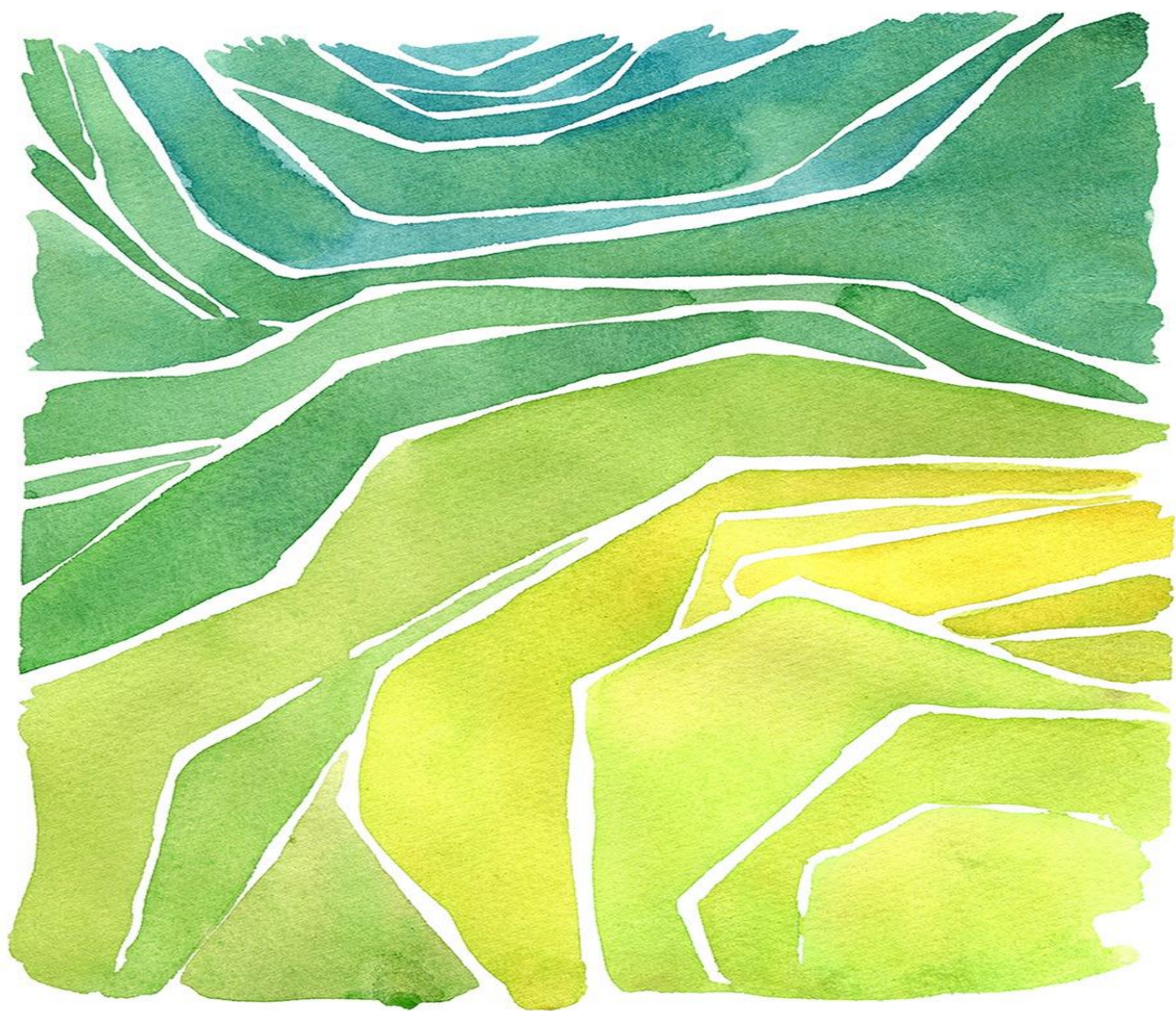




Biosil[®]

Superhydrophobic Silica

Technical Overview & Application Guide

Better products. Better prices. Better life.





About BSB Nanotech

Biosil is the world's first commercially produced bio-based amorphous silica manufactured with the highest degree of purity and synthesized for a wide range of applications.

Manufactured by BSB Nanotech in Vietnam, this silica is derived from Rice Husk (RH), a common agricultural waste in rice producing countries in Asia. The production of Biosil offers strong environmental, technical and commercial advantages in comparison with conventional methods of producing silica from sand & quartz

The vision of BSB Nanotech is to become a global producer and developer of premium industrial applications of RH-derived Nano Silica.

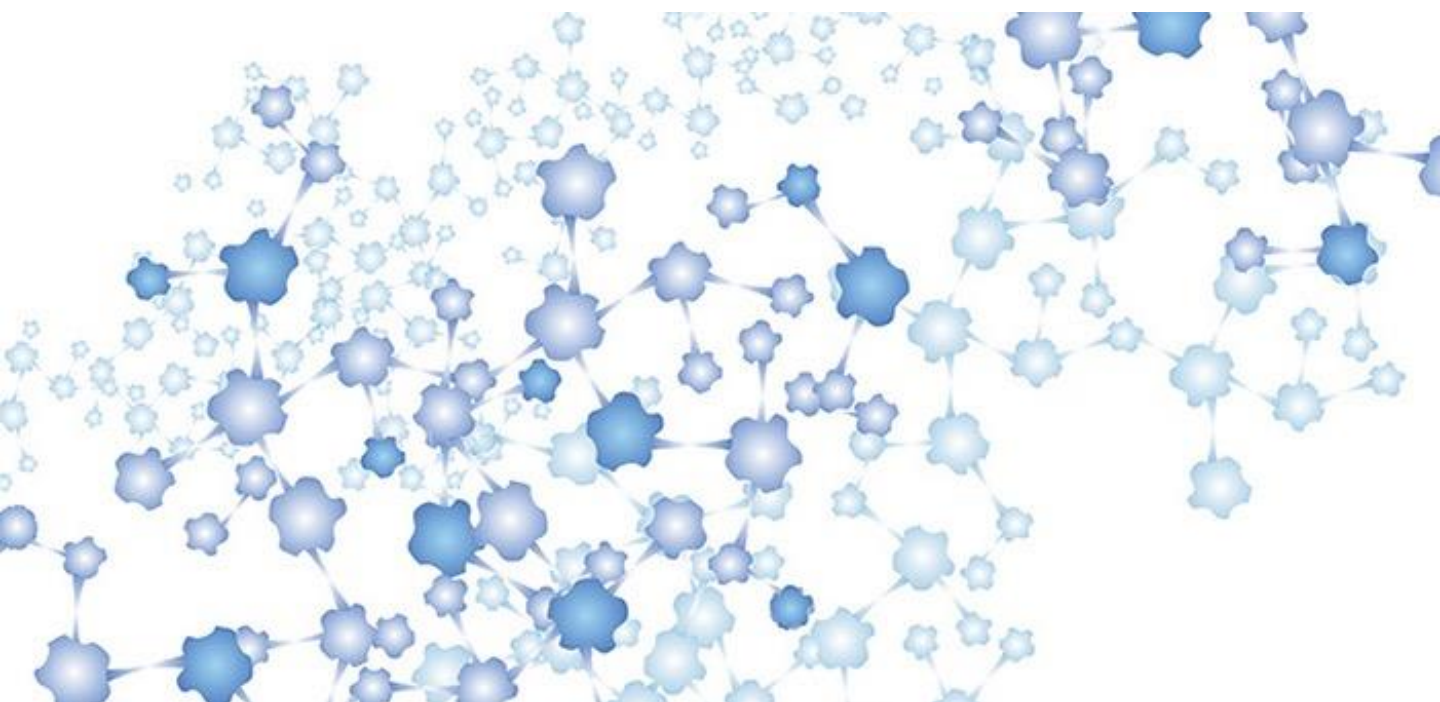
Key Milestones

- April 2017: Investment License in Saigon Hi-Tech Park
- November 2018: Pilot Plant Completion
- December 2018: First Commercial Order
- February 2019: Nano Lab Completion
- March 2020: Plant Upgrade Completion
- April 2021: Name change from BSB Development & Investment Co. Ltd to BSB Nanotechnology Joint Stock Company

Senior Management Team

- Hung Nguyen Viet, PhD, Founder & CEO
- Christopher Do, Chief Commercial Officer & Director





Silica



Natural Occurance of Silica. The two most abundant elements in the earth's crust are oxygen and silicon. The mass of Earth's crust is 59% silica. In nature, silicon is almost always combined with oxygen. Either exclusively in SiO_2 or in conjunction with additional elements (as is the case for silicates such as bentonites, montmorillonite, talc, wollastonite. The natural silicates form the basic raw material for key technical products such as cement, glass, porcelain, and bricks.

Basic Manufacturing Process. The silica is usually manufactured by both wet (chemical) and Thermal methods. The wet method yields precipitated/Colloidal Silica and silica gels, whereas the other method yields fumed Silicas, which can be further characterized to yield different grades of silica.





The Bio-Silica Production Pioneer



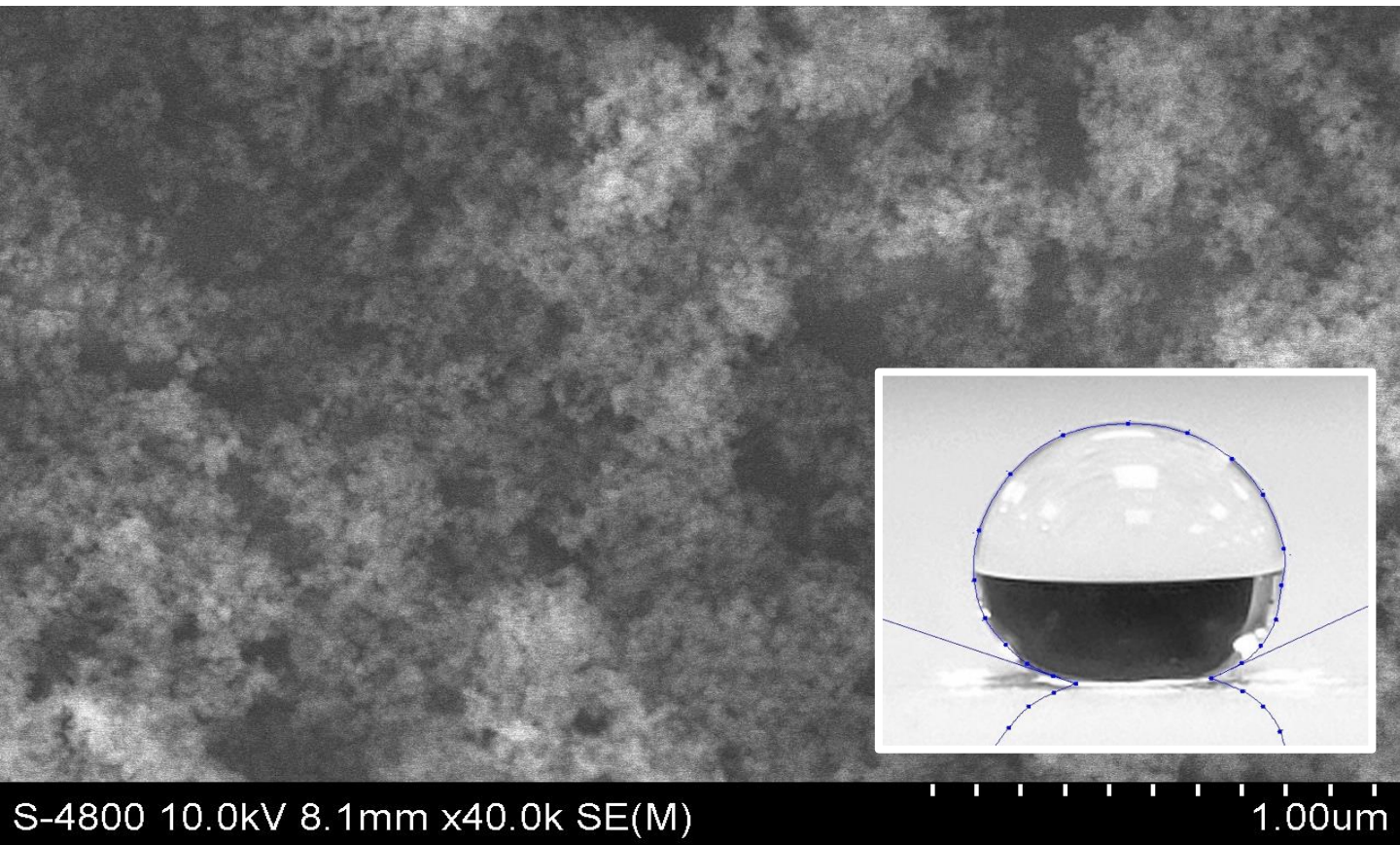
Asian countries are predominantly rice producers with Vietnam being one of the top five in the world. The extraction of silica from this renewable resource has been endeavored by many scientists and researchers.

Leading this scientific race, BSB Nanotech is the first company to successfully produce rice husk based nanoporous silica on a commercial scale in the world.

Strategically located along the waterways of the Mekong Delta in Vietnam, BSB Nanotech has brought together the abundant access to rice husk, state-of-the-art technologies and skilled professionals to develop a cost effective nanoporous silica in its purest form.

After four years of extensive research, Biosil was formulated to perfection, harnessing the highest amorphous silica content from rice husk and customised for various applications.





Superhydrophobic Silica

Superhydrophobic silica is a silica powder which is characterized by its water contact angle more than 150° and the sliding angle less than 10 °. Superhydrophobic silica particles are prepared by the chemical reaction of hydrophilic silica with reactive silanes (fluorinated/nonfluorinated).

Superhydrophobicity in silica is processed through surface modification / treatment. The hydrophobicity into the hydrophilic silica is introduced by reacting its hydrophilic group-ends (silanol groups) with certain organosilane functional groups.

These organic groups are introduced by reagents like Fluorinated silanes. These organic groups get anchored on the hydrophilic silica surface via formation of co-valent bonds. The surface modification changes the chemical properties of the previous non-treated hydrophilic silica hence hydrophobically characterize the silica surface, making the silica hydrophobic in nature.

No.	Parameters	Value
1	Particle Size	4 - 10 μ
2	pH Value (5% dispersion)	6.5-7
3	Loss on Drying (2 hrs @ 110°C)	0.5%
4	Tamped Density (g/cc)	0.25
5	SiO ₂ content (%)	≥85%
6	Oil Absorption	186 gm oil/100 gm silica





Applications

Superhydrophobic silica is a versatile product that can be used as raw-materials or as an additive in many industries such as paint and coatings as well as construction chemicals such as adhesives, automobiles and even solar-energy sectors.. The applications are aplenty and there are benefites in the application of Superydrophobic Silica in silicone rubber, sealants etc..

It is often manufactured as both single and multiphase composites in order to enhance properties such as dispersion, stability behavior, resistance to water, and functionality.

Some of the key **Application Sectors** of Superhydrophobic Silica covered in this guide includes:

- Automobiles
- Marine
- Aircrafts
- Solar-Energy
- Pharmaceuticals
- Self-cleaning Wearables
- Smart Sponges





Automobile - Self Cleaning

Automobiles serve as the main means for transportation in modern times. Designing a corrosion resistant car body (which enhances durability), as well as a clean windshield to ensure clear vision for the driver, are considered increasingly important factors for enhancing automobile security.

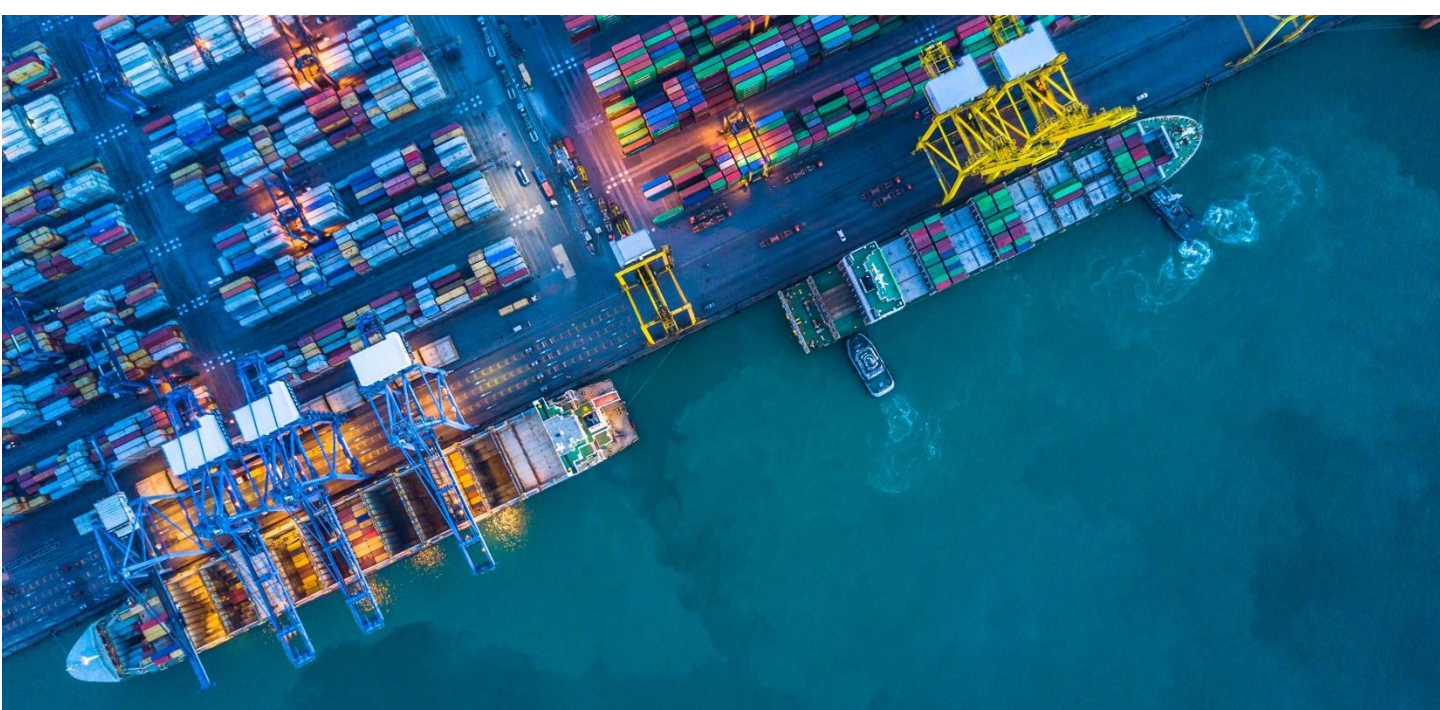
Wind Shield – Anti Fogging

Superhydrophobic coatings with self-cleaning and anti-fogging properties have gained increasing attention in their application to automobile wind shields. It is believed that the anti-fogging feature of the superhydrophobic coatings is caused by the high evaporation rate of tiny fog droplets formed on superhydrophobic surfaces. Also, superhydrophobic surfaces use a rolling mechanism which roll down the water droplets at very low tilt angles thus accelerates fog droplets to leave the surface.

Automobile Body

The corrosion from a car body's long-term exposure to the outdoors causes a change in performance and shortens the lifespan of the automobile due to physical and chemical interactions with the environment. The phenomenon not only affects the appearance of the automobile, but also engenders damage to related equipment, also the frequent use of cleaning agent and the impact of water will cause damage to the coating of the automobile. The **superhydrophobic coating** serves as a protective layer against corrosive environments, it can serve as a barrier against the corrosion of metal alloys surfaces and weaker adhesion strengths between the contaminants and the superhydrophobic surfaces. Thus, this slows down the corrosion rate and improves the self-cleaning capability of the car body and at the same time it enables the self-cleaning ability of automobile surfaces so that the water droplets can effectively clean the surface.





Marine – Anti Corrosion

Through the progress of economic development, high energy consumption and corrosion issues inevitably produced by various marine applications have largely affected marine transportation or operations, especially in the harsh marine environment. Herein, superhydrophobic coatings as a key technology can be usefully applied to improve **drag-reduction** of navigation objects in the water and the **anti-corrosion property** of marine vessels and infrastructures.

Marine Vessels

The **drag reduction** of underwater vehicles and surface ships can enhance sailing velocities and effectively save fuel consumption when sailing. **Superhydrophobic coatings with excellent water-repellency and low adhesion force** to water can be used for various marine vessels, including cargo ships, service ships, navy warships, submarines, etc. these can achieve a drag reduction effect and improve operating performance with significant advantages in facile fabrication and low energy consumption. For marine vessels, the frictional resistance from the water accounts for approximately 80% of the total resistive force consisting of frictional drag and pressure drag. They also possess slight anti-fouling capability because the entrapped air pockets decrease the contact between fouling and the surface

Marine Infrastructure

Marine infrastructures, including offshore-platforms, undersea-construction, pipelines and cables are critical to the the effective functioning of offshore energy and communications systems. However, the high salinity of sea-water causes salt corrosion of these infrastructures, therefore leading to financial losses, environmental contamination and even sudden accidents. Superhydrophobic coatings acts as a barrier between the substrate and water providing corrosion resistance to the above-mentioned infrastructures.





Aircraft – Anti-icing

Most aviation accidents caused by icing occur in airfoil and empennage. Typically, super-cooled liquid water in the clouds that remains liquid below zero and suddenly turns to ice and the existence of tiny pieces of ice are the main sources of icing during a flight. Ice formation and aggregation on an aircraft leads to the damage of equipment and hinders the operation of aircraft, thereby causing aerodynamic stall or even serious hazard. For aircraft, the current de-icing and anti-icing systems at cost of huge energy consumption on the ground and during flight, such as thermal, mechanical, or chemical treatment, etc., are not economic and environmentally friendly. They will release chemical substances into the environment, increase fuel consumption and add complexity and weight to the aircraft systems, especially the de-icing process, which needs to take more time and energy.

The nucleation rate and macroscopical growth velocity of ice can be greatly decreased by a **superhydrophobic coating made with Biosil superhydrophobic additives** because the trapped air in cavities can cause an extremely low actual contact area and reduce heat transfer between solid surface and liquid, leading to a delay in the time required for freezing.

The lower the ice adhesion strength, the easier it is to remove ice, which is desirable for de-icing. Thus, superhydrophobic coatings possess a low adhesion strength, showing a good icephobic property.





Solar Panel - Anti reflective coating

Significant part of the incident solar energy is lost due to the reflection at the air/glass interface as well as the accumulation of dust on the modules.

According to several published reports, dust deposition layer of 4 g/m^2 can decrease solar efficiency by 40%. A study found that despite heavy rainfall, the transmittance of solar panels had reduced to 87.6% from 90.7%.

High Surface roughness cause more light to scatter and reflect hence decreasing the solar-energy conversion of solar panels. To decrease the light reflectiong and scattering, superhydrophobic silica can be used in form of gels to produce anti-reflective coatings.

Superhydrophobic

The dust accumulation on the solar panels can be easily decreased by using the **superhydrophobic silica in self-cleaning coatings**.





Medical – Ultrasound Contrast Agent

Entrapped air microbubbles have been widely studied as ultrasound contrast agents for use in ultrasound-based diagnosis but also shown to have substantial potentials in ultrasound molecular imaging, ultrasound targeted drug/gene delivery, thermal tissue ablation, and sonothrombolysis for therapeutic purposes. and as drug/gene carriers for therapy. However, their size and stability (lifetime of 5–12 min) limited their applications.

Biosil's **superhydrophobic and porous nanoparticles** exhibit a significant and strong contrast intensity compared with other nanoparticles. The bubbles generated from superhydrophobic nanoparticles sustained for at least 30 min while lipid microbubble lasted for about 5 min under the same conditions.

Superhydrophobic Silica can be made a promising contrast agent with the potentials to serve as **theranostic agents that are sensitive to ultrasound stimulation.**





Superhydrophobic Wearables

The Superhydrophobic Silica can be used as Sole pigment or also as an additive to prepare a superhydrophobic coating which can also be spray applied/dipped coated onto various substrates to exhibit superhydrophobicity.

Rubber Gloves

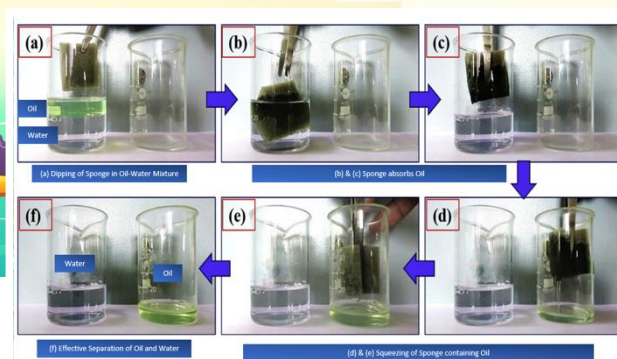
The latex rubber gloves have a versatile usage for different production fields such as agricultural, fishery, chemical industry, electronics etc. In particular rubber gloves can be spray applied or dipped into the superhydrophobic coating prepared by BIOSIL Superhydrophobic silica, due to its excellent water repellency, they can be made completely waterproof. It can also withstand certain acidic household chemicals.

Self-Cleaning Fabrics

Unlike other surfaces, apparels like shirts, trousers, shoes etc., are subjected to regular washing. Frequent washing of cloths requires copious amount of water, detergent, energy and machine or mechanical wash. Laundry detergent waste also adds secondary pollution to the environment. On the other hand, regular washing reduces usual shine and life of the cloths.

These appareals when coated with a superhydrophobic coating prepared by BIOSIL superhydrophobic silica can be made completely waterproof and it also shows excellent repellency towards many household chemicals like vinegar, Ketchup, mustard etc., and due to its self-cleaning ability, these fabrics do not retain spots or marks of such materials.





Smart Sponge - Oil Spill Sponges

An enormous oil spill in the environment especially into the ocean is one of the serious issues tackled around the world. Oil removal and collection is a tedious process. Many expensive and time – consuming physical, chemical and biological methods were adopted for oil spill clean – up like filtration, in – situ burning, gravity separation, centrifuge and so forth.

Usually, sponges absorb any kind of liquid and modifying it by hydrophobic materials can significantly change its wettability to superhydrophobic and superoleophilic at the same time. Such modified sponges can strongly absorb any kind of oil by repelling water concurrently. The modified superhydrophobic sponges can be used with high separation selectivity, absorption efficiency and reusability.

The secret to these sponge lies in its oleophilic, hydrophobic nanocomposite (superhydrophobic silica) coating. This chemical coating allows oil to be extracted from water with ease, meaning the process can turn any regular, cheap sponge into a smart sponge.



We customize our Bio Based Silica
to suit your specific needs.

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ARE
DRIVING YOU
CHANGE
OR ARE YOU
BEING DRIVEN
BY IT?

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