CG² NanoCoatings
Innovative Coating Solutions

ANTI-STAIN TECHNOLOGY

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Our team has considerable experience with anti-stain technology. The technology uses easily available and economical ceramic nanoparticles. These nanoparticles are essentially nano-chemical reactors that can be functionalized in various ways to achieve the desired properties:

- Some reactive groups allow the particles to bond with the underlying material. This bond utilizes strong chemical forces which are around one million times more powerful than the purely physical interaction that is present in coatings made using standard mixing or deposition techniques.
- At the same time, by using other chemical functionalities, the particles can be designed to exhibit several different capabilities such as anti-adherence, scratch resistance, reduced friction (i.e. tribological enhancement), corrosion resistance, etc. For example, the addition of only 3% silica nanoparticles (one type of ceramic nanoparticle) also increased abrasion resistance by approximately 400% while using 10% resulted in an increase of approximately 945%.

Since the nanoparticles are so small (a few nanometers in diameter), if properly functionalized, they do not set when dispersed in an appropriate liquid. The particles continue to float indefinitely, as depicted on the right hand side of Figure 1 below. The processes to accomplish this are a key part of our technology. The result is a coating that has good coverage with less coating material, superior interaction with a variety of substrates, and greater durability. In particular, the nanoparticle coating is durable because the particles do not segregate from the coating over time, which is a problem with many other coatings on the market.

Figure 1: Schematic depiction of a nanoparticle as a nano-chemical reactor

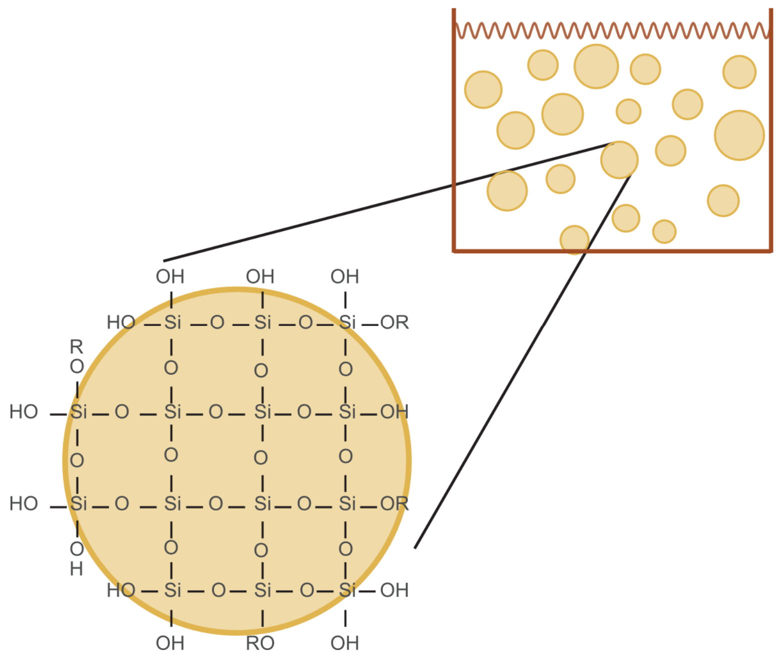


Figure 1 also shows that the nanoparticles retain on their surfaces a number of either un-reacted or still active chemical groups which can be used as sites for chemical reactions. This property allows the attachment of moieties (chemical groups with specific functionalities) or even organic molecules (e.g. short-chain polymers) to these sites to produce nanohybrid materials, thus allowing the functionality of the coating to be further modified.

The system is physicochemically designed to induce partial segregation of the oil and water-repellent molecules to the surface upon drying while keeping the nanoparticles evenly distributed throughout the whole film, with essentially no agglomeration. This is schematically illustrated in Figure 2 below and by Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) images in Figures 3 to 5. Figure 2 also shows that there are two types of oil- and water-repellent molecules, namely mono- and bi-functional, which are represented as loose and tight ends respectively. This is a key reason why our coating technology is effective protection against a variety of agents.

Figure 2: Stratigraphy of the stain-repellent nanocoating

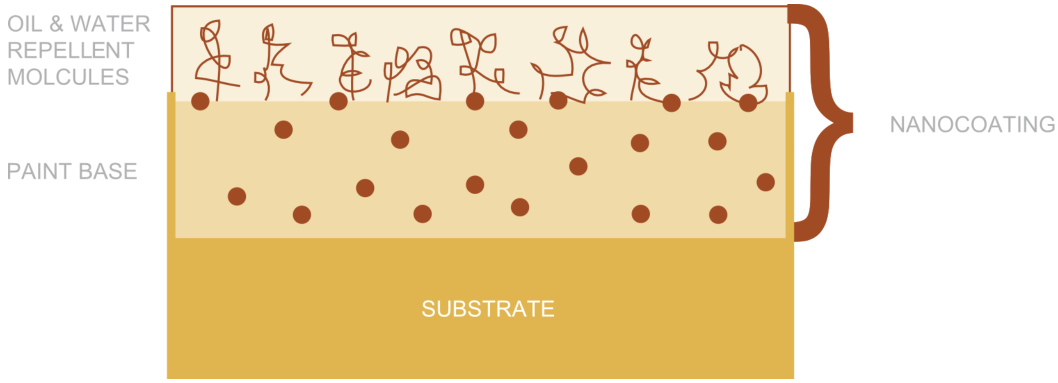


Figure 3: TEM image showing silica nanoparticles dispersed in a polymer matrix without any agglomeration. The particle size is approximately 20 nm.

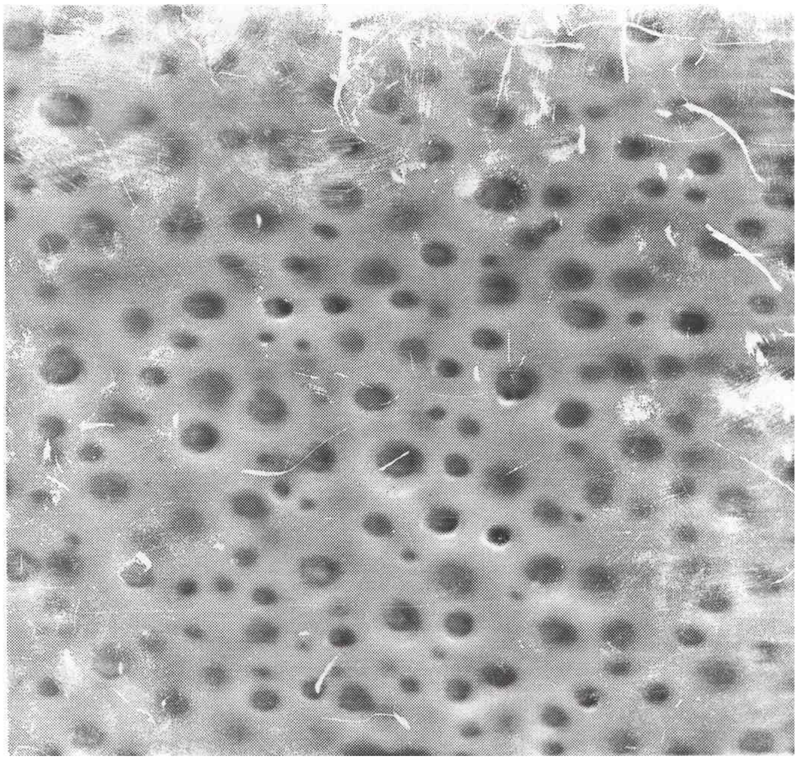


Figure 4: TEM image of a coating after 4 years showing that the particles have not coalesced. The scale line in the bottom left represents 25 nm.

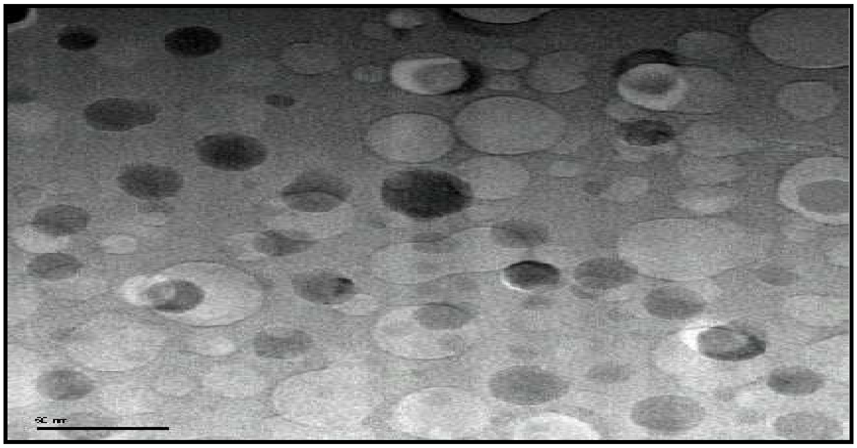
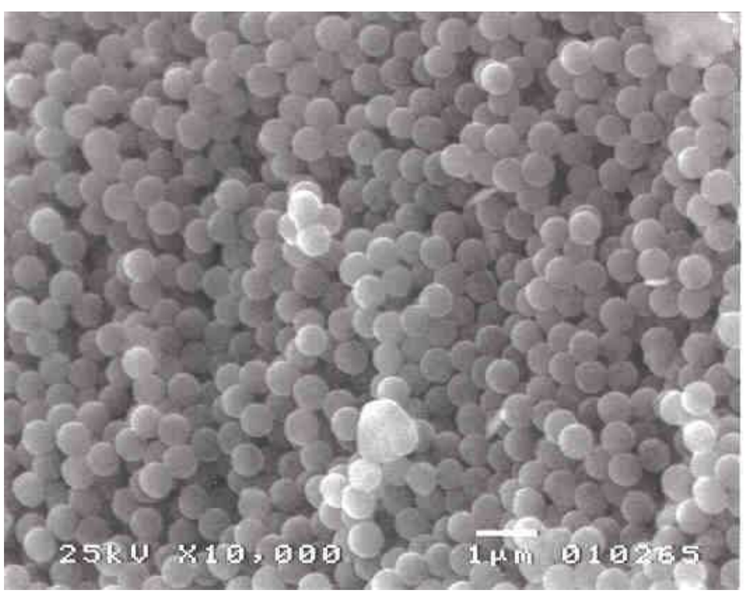


Figure 5: SEM image of silica nanoparticles (larger ones than those in the previous pictures) after being functionalized by our technology. The particles were suspended in alcohol and a drop was deposited onto a microscope sample holder and the alcohol evaporated. The particles remain separated even when there is no liquid to be suspended in i.e. a dried sample.



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While each situation is unique, typically we envision a two-component coating system consisting of a high-performance polymeric base and a catalyst. The base would include hydroxylated resin, silica nanoparticles, oil- and water-repellent molecules, and a cross-linking agent. The characteristics of the coating will normally include:

- The entire system will be water based, resulting in a VOC near zero.
- The uncured coating will be in liquid form for compatibility with the required application methods.
- The coating should cure at either room temperature or under typical manufacturing conditions.
- The coating will be designed to be transparent to not significantly affect the appearance of the substrate.
- The ceramic nanoparticles will make it durable to weathering and abrasion. It should also be resistant to crumple since the coating contains a nanoparticle network that will facilitate recovery.
- The coating is projected to have good chemical safety characteristics. In the uncured form it will be a water-based material with no fumes and in the cured form it will be a highly stable cross-linked structure.
- Standard manufacturing techniques and equipment should be sufficient to functionalize and prepare both the nanoparticles and the matrix.

