

QUICK GUIDE TO GLASS SURFACE TREATMENTS

“Facts that Do Matter: What You Really Need to Know”

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ABSTRACT

There are many companies around the world providing glass surface treatments today. Many of them simply sell a private labeled brand (someone else's product) and only a few own their intellectual property, meaning that there are only a few companies that have truly done enough research and development to come up with their own product with distinct and valid claims, along with a solid track record, to support what they promote. The purpose of this document is to provide clarity to the public with regards to the **core characteristics of glass surface treatments** that one should be aware of (to make a smart choice) but more specifically with regards to *hydrophobic* (water repellent) or the so-called *easy-to-clean* glass coatings. The Q&A format has been chosen for simplification purposes and in order to explain in a more colloquial manner to any end-user rather than to an expert in this related field.

Added-Value Functions: Core Properties of Easy-to-Clean Coatings

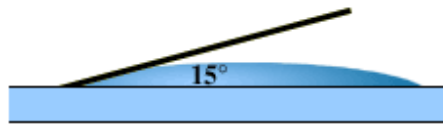
Q&A

a. **How hydrophobic is the surface and why do you need to know?**

As its name denotes, one of the first and foremost core properties of any *hydrophobic coating* that one should know is precisely how *hydrophobic*, or water repellent, the coating makes the surface. Why? Simply because the more hydrophobic the surface becomes, the easier it will be for the treated surface to be cleaned. It works like a Teflon® cooking pan and the difference in cleaning a Teflon® coated pan vs. a non-Teflon® one.

b. **How do you measure the water-repellency or “hydrophobicity”?**

The measurement that defines how water-repellent a surface is after being treated with a hydrophobic coating is called “contact angle”, also called ‘wetting angle’, which is the angle formed by the material's surface and the tangent of the interface between the fluid (i.e.: water) and the environment at the point of contact (the glass surface for example). SEE GRAPHIC BELOW (typical contact angle on untreated glass surface).



c. Does the so-called “contact angle” define quality and durability of the coating?

This is probably the **single most relevant question one can ask about any hydrophobic easy-to-clean coating and perhaps the MOST HIDDEN fact by most coating suppliers as it truly uncovers the truth behind the quality of the product.** Yet, most coating suppliers will typically evade this critical issue with all sorts of misleading statements and false claims. The unequivocal and irrefutable scientific FACT is the following: the important fact to know is not necessarily the initial contact angle measurement after the glass surface is treated but rather how it will perform over time or, in other words, how will the contact angle behave with the normal tear and wear once the surface is exposed to the different environments. Most *hydrophobic* easy-to-clean coatings have an initial contact angle anywhere from *as low as 80 degrees to 120 degrees*. The ones that are on the low end, especially under 95 degrees, are not interested, for obvious reasons, in disclosing any measurement thus they downplay or completely disregard any value to contact angle measurements, as they would not want to lose any “marketing edge” vs. any higher contact angle coating. You may hear a supplier calling this issue “**the war of the bubbles**” and the lack of relevancy they allocate since it really “doesn’t matter”, they claim. NOT quite so as **it does matter and you should know why to therefore make a smart decision** when choosing a coating for your own use, whether you are the owner of a building, business or simply for your own household or automotive use.

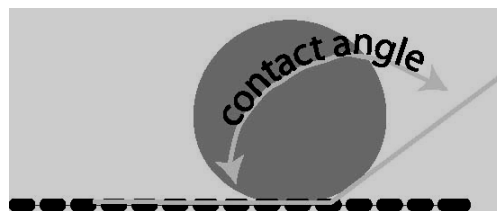
Specifically, the important aspect is to know how the contact angle measurement varies over time, thus if your coated surface still remains at a relatively high contact angle AFTER a significant period of time, let’s say after 1,2, 3 and more years to then be able to **TRULY ASSESS the quality of the coating without the need to re-apply every few months, which is the case with MOST other coatings as they do not have a PERMANENT BOND.** The analogy that I often draw out of this question is the following: if you are purchasing a computer, one would want to know the specifics about the computer’s storage (such as its memory) and/or performance capabilities (such as hard drive) Likewise, not having any information about the contact angle, from a purely scientific or empirical perspective, is like not knowing how much hard drive space or memory your computer has. This is simply a matter of accuracy and disclosure of scientific facts that DO affect your every day life by having access to improved performance. The same way anyone likes having the best cleaner in the house, or perhaps the best paint for the living room walls, one should know the difference between mediocre, good and excellent *hydrophobic coatings* to enhance your glass surfaces and keep it cleaner for longer periods of time thus reducing the required maintenance.

d. Why do most coatings NOT publicize or disclose their contact angle measurements?

As pointed out in the previous question, it is a simple matter of not having any disadvantage in one's sales and marketing strategy. Any company that is either unwilling or reluctant to disclose such key element of any "fact sheet" lacks credibility and one should legitimately question the quality of the coating itself. It is equally relevant to point out that we at DFI are perhaps **the ONLY supplier in the world that not only make our contact angle measurements public but will also challenge ANY OTHER COATING to perform durability tests**, side by side under the same identical testing protocol by any reputable independent laboratory of mutual choice, to compare overall quality, including but not limited to optical clarity, water-repellency, abrasion resistance to then unequivocally demonstrate unbiased overall performance.

e. What is the difference between the so called "self-cleaning" glass and any other easy-to-clean or hydrophobic glass?

Self-cleaning glass consists of a *hydrophilic* coating with photocatalytic properties fused into the glass at high temperatures during the manufacturing process. This type of coating typically reacts with the sun's ultraviolet light and water (rain or induced water spray). Thus, these two elements (sunlight and water) must be present for the coating to be effective, creating a sheeting action so that water can easily rinse the loosened dirt away. Due to its integral characteristics, there are many limitations to this concept of "self-cleaning", such as the following: glass must receive both sunlight and water, it is not applicable to all kinds of glass, cannot be applied in the field but rather at manufacturing level only (making repair or replacement a lot more expensive), it's typically a lot more expensive than hydrophobic coatings. By contrast, DFI's hydrophobic coating requires no 'activation' since it chemically reacts during its own process in less than 2 seconds and immediately bonds to the surface. Although other theories refer to the "self-cleaning" glass as those coatings with contact angles in excess of 105°, where the mechanical action required is virtual unnecessary and no accumulation of contaminants occurs, I strongly believe that the misconception of *self-cleaning* is contrary to the reality and expectations of an end-user. It is my opinion that for any glass to truly be called self-cleaning it would have to have a contact angle of **180 degrees** to then create a "**rolling effect**" (as shown in GRAPHIC below) so that no action will be required for the water to automatically roll off the treated glass hence leaving the surface entirely dry as if no water touched the surface. This **ultra-hydrophobic** concept is virtually the only way that one may legitimately claim the glass is *truly self-cleaning*. Anything beyond this concept is, misleading and therefore lacks credibility.



Ball "Rolling Effect" of an ultra-hydrophobic surface (over 145 deg. of contact angle)

f. Is it important whether or not a coating is classified as “nano” and does it affect the quality itself?

Nanoscale technologies are the development and use of devices that have a size of only a few nanometers. The prefix nano means ten to the minus ninth power (10^{-9}), or one billionth of a meter, a simple metric measurement. However, what's relevant is not the thickness of the coating itself (1-100 nanometers or some other “micro” measurement) but rather, what the coating actually is. What does it do? By what process does it work? What does it provide as an overall ADDED-VALUE product? . Therefore, just because something can be measured on the nanoscale level, it is not a guarantee of quality. Many chemicals can be spread out thin enough to be measured on the nanoscale, but it does infer a degree of inventiveness and does enable certain capabilities by virtue of being able to manipulate atoms at that much smaller levels. In the case of our patented **Diamon-Fusion®** coating, the chemical treatment itself provides, in chemical terms, a very durable “branched, cross-linked and capped” optically clear nano-film and a permanent bond is integrated into the glass itself as the nanofilm actually grows from the inside out and literally changes the molecular composition of the surface. This is truly a unique process unlike any other coating. The KEY is durability and how the coating, nano or not, will stand over time, and how that “bubble” (water droplet), as defined by the contact angle measurement as previously described, will behave with the passage of time, namely normal wear and tear.

More specifically, DFI's nanotechnology, patented worldwide and branded under the Diamon-Fusion® trademark, uses a two-stage chemical process. The chemical reaction created in the first stage causes the "cross-linked" and "branched" ultra thin silicone film (*nanofilm*) to be grown from below the surface out. The second stage 'caps' the entire chain of atoms. This unique 'capping' substantially increases the hydrophobicity and durability, leaving, chemically speaking, no points of attachment for contaminants and creating a truly repellent charge. Through simple neutralization, all chemicals become inert within a few seconds. No curing time is needed since the chemical reaction itself occurs in less than 2 seconds.

g. Are all easy-to-clean coatings environmentally friendly?

Depending on the chemical composition and method of application, some coatings may be more harmful to the environment than others. The **Diamon-Fusion®** patented nano-coating is based on an environmentally safe scientific process. The chemicals used in our patented process have been in use for over 55 years in the aviation industry, for different applications, and are not found in the "Clean Air Act"(1) or the “Clean Water Act”(2). There are also no PELS (permissible exposure limits) set by OSHA (3). We have implemented, with our extreme eco-friendly philosophy, the highest standards in the handling of our chemicals so that any scientific process we may use is safe to the environment. Thus, we have engineered an ultra efficient yet simple neutralization system that renders our chemicals and their by-products completely safe and inert. We strive not only to protect the environment but to preserve it from any contamination or pollution.

- (1) The 1990 Clean Air Act is a federal law covering the entire United States of America, whereas the individual states (like California or New York) do much of the work to carry out the Act. For example, a state air pollution agency holds a hearing on a permit application by a power or chemical plant or fines a company for violating air pollution limits.
- (2) In 1972, the US Congress enacted the first comprehensive national clean water legislation in response to growing public concern for serious and widespread water pollution. The Clean Water Act (CWA), formerly known as the Federal Water Pollution Control Act, intended to "... restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Section 101).
- (3) Occupational Safety & Health Administration, US Department of Labor: OSHA's mission is to ensure safe and healthful workplaces in the US.

h. How is the Diamon-Fusion ® nanocoating applied: is there one single method and only in the vapor chamber system?

This is perhaps the **single most misleading statement** often made by other suppliers about our application processes. Our Diamon-Fusion® patented coating, unlike any other coating, can be delivered in FIVE (5) different methods, indeed enabling the **most flexible capabilities** of any easy-to-clean coating in the world, as follows:

- 1) The ultra-efficient *VAPOR Deposition System* produced in a "batch process" inside an air-tight chamber. The glass is automatically treated on BOTH sides of the glass.
- 2) The *HVLP* (High Volume Low Pressure) Spray System, which is done in a manual pulverized (atomized) form with an effective air spray gun.
- 3) The *HAB* (Hand Applied *Generation "B"*), which is an effective way to manually apply our patented system. Recommended for smaller volumes where high yield and productivity are not necessarily a big factor.
- 4) The *NanoPax™* System, which is an effective pre-moistened towelette (*wipes*) distributed in single units. This provides great capabilities for multi-level distribution.
- 5) The *On-Line Production* System for any conveyer-belt massive production, which has been fully conceptualized but not yet in production at any location.

NOTE: it is important to point out that ALL 5 different application methods, although they do not necessarily all have the same chemical formulation, they are all covered by the same patent and they all provide the SAME BENEFITS and core properties besides *ALL being eco-friendly*.

Thus, DFI provides a wide range of PRODUCTION CAPABILITIES LIKE NO OTHER COATING, for ALL budgets, ALL volumes and with a global distribution network.

i. Does DFI distribute its products ONLY under a license?

The **Diamon-Fusion®** patented system, in its 5 different forms (as described above) is essentially distributed under a license given its unique qualities and intellectual property attached to it, unlike any other coating in its category. However, DFI has recently developed a number of NEW coatings that will be available during Q2-2009 that will compete with all other coatings and which will have NO licensing requirements of any kind. This new family of products, called **Value-Fusion™**, will include the following products, designed for specific markets where economic considerations require “VALUE” alternatives to attract additional markets:

Clear-Fusion™ for Residential, Commercial and certain Transportation markets,

Aqua-Fusion™ for the Marine industry; and

Opti-Fusion™ for Electronics and related fields.

All these new products will have no licensing requirements and will be available in the market during Q2-2009 although certain minimum purchase volumes may apply depending on each market or region.

j. What other additional benefits do easy-to-clean coatings have beyond the water repellency effect?

Most easy-to-clean coatings offer the single characteristic of being water-repellent (*hydrophobic*) and slightly oil-repellent (*oleo-phobic*) as its core property. **Diamon-Fusion®** patented coating, on the contrary, provides multi-functional characteristics that include: water and oil repellency (*hydrophobic* and *oleophobic*), impact and scratch resistance, protection against graffiti, dirt and stains, finger print protection, UV stability, additional electrical insulation, protection against calcium and sodium deposits and increased brilliance and lubricity. DFI's nanocoating, as previously described, works at nanoscale levels to change the molecular composition of any silica-based surface. **Diamon-Fusion®** provides, also as previously described, , a 'cross-linked', 'branched' and 'capped' optically clear **nano-film** along with a strong and durable *covalent* bond.

k. Why is important to have a PATENT behind any product?

You might have heard the saying *necessity is the mother of invention*. But not all inventions produce the benefit of a GRANTED PATENT as a result. Patents are granted and issued in an effort to foster scientific advancement and economic prosperity. I am a fervent believer in *meritocracy*, and “intellectual property” is one’s idea or invention translated into such a highly functional (physical) form with such degree of *inventiveness* which then truly merits the “protective shield” granted by a Patent Office. The patent gives the inventor the “exclusive right”. Many ideas are filed under a patent but many (if not most) never actually get an issued (granted) patent as they remain under a “pending” status or eventually get rejected, mainly for lack of inventiveness.

It is therefore very important to distinguish the difference between a “patent pending”, in its *primitive* or early filing stage and an ISSUED (granted) PATENT, which is typically valid for 20 years in most countries. In specific relationship to any value-added product, it is relevant to understand that a patent truly reflects a vast amount of research and development that a company was committed to invest over time to bring something *unique and different* (than any other product) to market: an **ingenious invention** unlike anything else as seen to-date which merited the issuance of a patent.

Therefore, in the case of the **Diamon-Fusion®** coating, it is only fair to say that its degree of inventiveness and intrinsic values are literally LIKE NO OTHER by simple virtue of being granted **patent(s) worldwide**, so far by the following Patent Offices: *Australia (patent #764724), Canada (patent # 2349480), China (patent # ZL 99815358.3) EU, European Union (patent #1137496), Israel (patent #142940), Japan (patent # 4230114) Korea (patent # 0436522), Mexico (patent # 230482), New Zealand (patent # 528143), South Africa (patent # 9641) and United States (patent # 6245387)*. It is also equally important to point out the investment required to file and pursue the issuance of any patent on a global basis. This collective intellectual property is what merits the sale and distribution of our unique Diamon-Fusion® product under the format of a *license agreement*, which ultimately protects the right of the user against inferior products.

As we strive for scientific truth with integrity, we always urge anyone to contact us with any question or comments you may have about our technology or any other products.

For additional information about DFI products, please visit its award-winning website at:

www.DFI nanotechnology.com

You may also find a very useful link with **Frequently Asked Questions (FAQ)** and a **media player** in every section to actually **LISTEN** to DFI’s entire website content along with a video presentation of the company.

*Teflon® is a registered trademark of E.I. DuPont de Nemours and Company