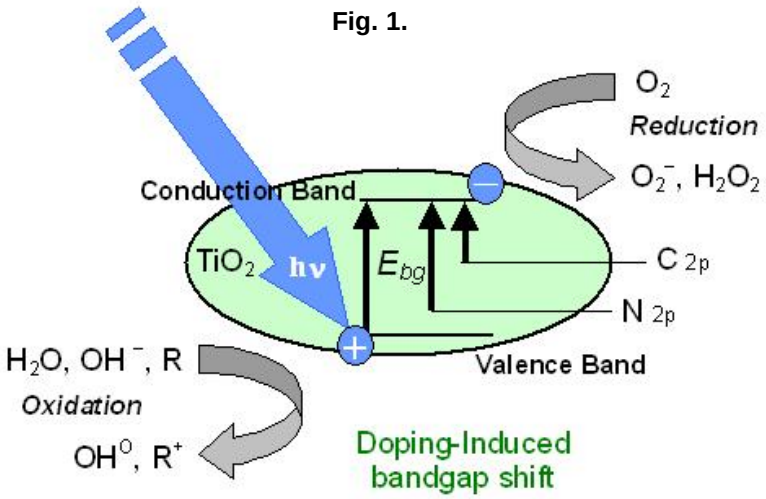
NEW FOR WATER AND AIR PURIFICATION:

NANOPTEK Visible Light Titania™

Clears Dyes in Water More than 20X Faster than the Industry Standard in Sunlight, and Continues to Work Even with Indoor Lighting

Titania (titanium dioxide or TiO_2) is useful in a wide variety of photocatalytic applications, such as generation of hydrogen from aqueous media, and disinfection and detoxification of gases, liquids, and surfaces. Ultraviolet illumination of titania produces positive charges, or holes, and negative charges that dissociate water molecules provided by even ambient humidity in air into hydroxy ions (OH^-) that are adsorbed on the titania, and hydrogen ions. Hydroxyl radicals ($OH^\bullet$) are then formed when the hole accepts an electron from the adsorbed hydroxy ion (Fig. 1).

Fig. 1.



These highly reactive $OH^\bullet$ radicals are powerful oxidizing agents, second only to fluorine and many times stronger than concentrated bleach. Hydrogen peroxide (H_2O_2) and oxygen radicals (O_2^-), also powerful oxidizers, are also formed. These agents have been shown to act together or separately to dissociate many organic molecules and other pollutants into harmless compounds, such that they can be used to remove contaminants from air and water, killing even drug-resistant bacteria and viruses on surfaces or in air and water, and reducing NO_x and other pollutants in air. As a result, titania photocatalysts are found now in commercial applications ranging from self-cleaning films on windows, to self-cleaning buildings built from titania-containing concrete, and to indoor air and surface disinfection when activated by artificial ultraviolet light sources.

However, ground-level sunlight contains less than 5% ultraviolet light, and indoor illumination has little to none, and so commercially available titania photocatalysts have limited effectiveness outdoors, and indoor use requires artificial ultraviolet light sources that add capital expense. Such UV sources must be shielded from skin and eyes, or require expensive vacating downtime during purification, and the more "germicidal" UV sources create ozone pollution. Further they are expensive to operate because of their inefficient conversion of electricity to ultraviolet light.

Nanoptek's Visible Light TitaniaÔ (VLT™) photocatalyst is band-gap-engineered to absorb not only UV, but also visible light and into the near IR, giving rise to the dark gray color in Fig. 3 and the red absorption spectrum in Figure 2. This additional light absorption results in *VLT acting over 20 times faster* than, for example, Degussa P25 in dye remediation (Fig. 4). Nanoptek's proprietary bandgap engineering process comprises greatly improved carbon (TiO_2:C) and/or nitrogen (TiO_2:N) doping that may also be combined with stress-induced bandgap shift.

As with other photocatalysts, Nanoptek's VLT powder can be added directly to water for remediation with the mixture exposed to sunlight in a container that is transparent to the full solar spectrum, either at "one sun" or at the focus of an optical concentrator (See Nanoptek CSHGs). The processing of the mixture can be batch type, where it is held until completely detoxified and/or disinfected and then released, or in a flow, or a combination of the two. The VLT is reclaimed by either filtration or simply by allowing it to settle out of the liquid.

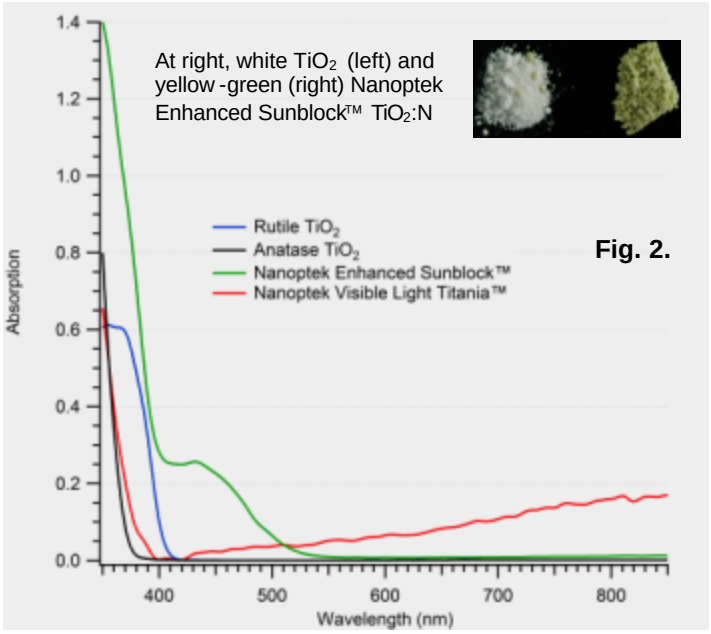
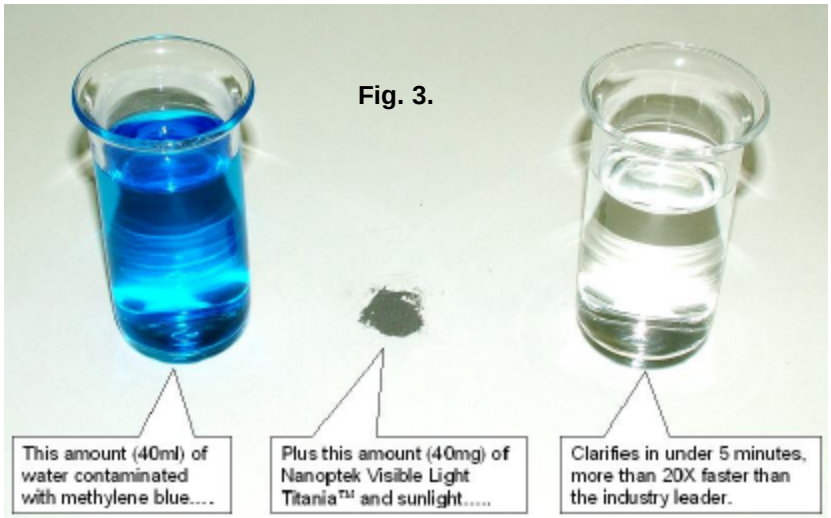
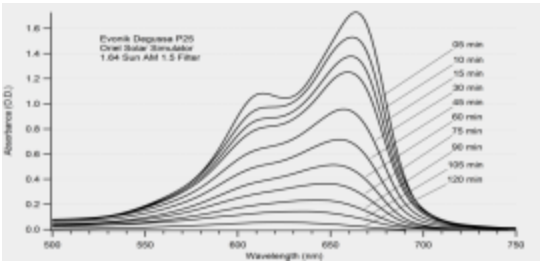
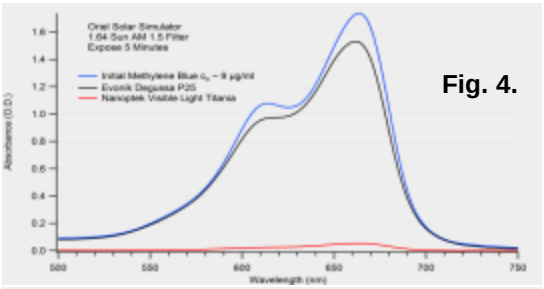


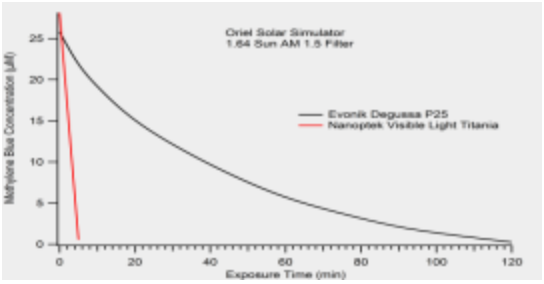
Fig. 2.

Interested in Contract Manufacturing or Licensing? Please contact us.









Alternatively, it can be bound to a flat or cylindrical or other surface over which the liquid is flowed while illuminated.

We anticipate that for air and surface disinfection and detoxification, Nanoptek's VLT powder will be adhered to surfaces such as fibers in HVAC filters or face masks, fabric for protective clothing, sheet paper, and envelopes. It can similarly be adhered to the interior of air-carrying ducts such that, when the interior is also illuminated with light, the ducts are self-sanitizing. VLT can similarly be bound into or onto concrete, plaster, stucco, paint, ceramic, ceramic glaze, floor surfaces, wallpaper, and other interior and exterior surfaces in kitchens (especially food-handling surfaces such as countertops and cutting boards), hospitals, bathrooms (including fixtures such as sinks, toilets, bathtubs), automotive (and also marine and aeronautical) surfaces including cabin interiors, exterior paint finish, headlights, and windows, or any surfaces that are frequently touched by people such as keypads and screens on personal digital devices, or shopping cart handles. So-called self-cleaning building exteriors would incorporate the visible light titania not only into or onto their polymer, glass or concrete surfaces, but also onto their aluminum, stainless steel, copper, or other metallic exterior coverings. VLT powder can be applied to such surfaces by several means, including electrostatic powder deposition, sol gel deposition, inkjet printing, pressure bonding, adhesion bonding, mixing with binders and then spray painting, mixing with concrete and then applying or casting, mixing with plastic resins and then molding, casting, or extruding into sheets, fibers, or other forms.

"Greater than 20X faster dye remediation in sunlight, and continues to work without UV"

Nanoptek's Enhanced SunblockÔ (green absorption spectrum in Fig. 2) is bandgap-engineered to absorb in the visible light spectral range of 390-550nm. Maximizing visible light absorption (without regard to photocatalytic activity) is desirable for sunscreen applications that require blocking not only the damaging ultraviolet in sunlight or other light sources, but also of much of the damaging high energy deep blue visible light. For example, titania is currently employed in sunscreen lotion to absorb the ultraviolet, but additionally zinc oxide and/or organic compounds are added to further absorb the ultraviolet as well as damaging deep blue light. Increasingly publications raise concern that the organic compounds used may break down into possibly carcinogenic chemicals. Nanoptek's Enhanced Sunblock™ may potentially replace these volatile organic compounds. Additional applications include mixing the visible light absorbing titania powder into plastics, paints, glass, or other materials for which it is desired to block the ultraviolet and high energy blue light more completely.

NANOPTEK
New energy for a new world™

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