

**Table S1.** Summary of the most significant patent reviewed in the field of photocatalytic water treatment (2010 – 2020).

Type of reactor	Photocatalyst	Brief description	Advantages	Year	Reference
Vertical plug flow reactor	Not specified	The device comprises an internal diffusion vertical plug flow reactor tanks (series and/or in parallel), arranged on a skid base	<ul style="list-style-type: none"> <li>✓ Improved efficiency</li> <li>✓ Reduced volumes</li> <li>✓ Low cost</li> </ul>	2020	[1]
PEC	Not specified	The device includes at least one cathode and one anode; the waste solution may be introduced in the photoelectrochemical cell through different inlet	<ul style="list-style-type: none"> <li>✓ Improved efficiency</li> <li>✓ Reduced loss of material</li> <li>✓ Reduced use of reagent</li> </ul>	2019	[2]
Not specified	Not specified	Decolorization of reactive anthraquinone dye: salt supplying and an alkaline material to control salt concentration and to adjust the pH	<ul style="list-style-type: none"> <li>✓ Efficient decolorization</li> </ul>	2012	[3]
Photocatalytic fuel cell	CdS coated TiO <sub>2</sub> (or similar)	The photocatalytic fuel cell device produces electricity (or hydrogen) by consuming biomasses in presence of photocatalyst under visible light energy source	<ul style="list-style-type: none"> <li>✓ Low-cost</li> <li>✓ Ambient conditions</li> <li>✓ Energy production</li> </ul>	2015	[4]
Photocatalytic reactor with different zones	Nano TiO <sub>2</sub> catalyst	The invention includes different treatment module, with two different UV lamp located in the reaction zones.	<ul style="list-style-type: none"> <li>✓ Improved efficiency</li> </ul>	2019	[5]
Photocatalytic reactor with inclined surfaces	Not specified	The photocatalytic water treatment device includes a light source, provided of a light source adjustment to change the light intensity from 380 nm to 840 nm	<ul style="list-style-type: none"> <li>✓ Improved efficiency</li> <li>✓ Improved light efficiency</li> </ul>	2020	[6]
Not specified	Graphene photocatalytic stone	Th invention includes a primary purification part, an intensive treatment part and a photocatalytic purification part, separated by concrete walls	<ul style="list-style-type: none"> <li>✓ Improved efficiency</li> <li>✓ Use of solar energy</li> </ul>	2020	[7]
Tube-type photocatalytic reactors	Not provided	Device provided of tube-type photocatalytic reactors (lamp source 185 nm and 254 nm) placed side by side vertically and connected end-to-end	<ul style="list-style-type: none"> <li>✓ Improved efficiency</li> <li>✓ Low cost</li> </ul>	2019	[8]
Photocatalytic reactor with premixer	Not specified	The invention allows the remotion of refractory substances by using UV light irradiation, in presence of oxone, H <sub>2</sub> O <sub>2</sub> , TiO <sub>2</sub>	<ul style="list-style-type: none"> <li>✓ Improved efficiency</li> </ul>	2019	[9]
Cylindrical tank	TiO <sub>2</sub>	Series of photocatalytic plates (light-weight ceramic - inclination of 10-25° with respect to horizontal) with wavy catalyst coated surface, several reflecting plates, and UV-LED sources	<ul style="list-style-type: none"> <li>✓ Improved efficiency</li> <li>✓ Improved light efficiency</li> <li>✓ Reduced volumes</li> </ul>	2017	[10]
Not specified	Not specified	Ultrafiltration reverse osmosis combined with advanced oxidation technology for treating a glyphosate wastewater system	<ul style="list-style-type: none"> <li>✓ Low cost</li> <li>✓ Low energy consumption</li> <li>✓ Improved efficiency</li> </ul>	2015	[11]
Not specified	Not specified	The invention includes multiple UV lamps, and the possibility of introducing a regeneration treatment solution while other auxiliary agents can be used for the wastewater treatment	<ul style="list-style-type: none"> <li>✓ Low cost</li> </ul>	2015	[12]
Not specified	Not specified	The invention comprises a photocatalytic-hydrogen peroxide synergistic oxidation treatment of aniline wastewater, with a catalyst recovery device is present	<ul style="list-style-type: none"> <li>✓ Low cost</li> <li>✓ Improved efficiency</li> </ul>	2015	[13]
Not specified	Not specified	The invention provides a multi-stage wastewater equipment and process, with several parallel photocatalytic reactors	<ul style="list-style-type: none"> <li>✓ Low cost</li> <li>✓ Improved efficiency</li> </ul>	2020	[14]
Cylinder reactor	TiO <sub>2</sub> film	The photocatalytic water purification device is a cylinder composed of a wire coated with TiO <sub>2</sub> . The infrared lamp is in the cylinder	<ul style="list-style-type: none"> <li>✓ Low cost</li> <li>✓ Improved efficiency</li> </ul>	2020	[15]
Reactor filled with photocatalyst	TiO <sub>2</sub> /ACF composite	The device (for lab or small-scale) is composed of a sewage tank with a filtration system (activated carbon); the photocatalytic reactor is connected to the filtering system	<ul style="list-style-type: none"> <li>✓ Improved efficiency</li> <li>✓ Recycling of the catalyst</li> </ul>	2020	[16]
Photocatalytic U or I modules	Not specified	A swimming pool water treatment system with a photocatalyst module, the treatment system comprising a water supply system and an advanced oxidation sterilization device (Fenton oxidation, electrooxidation, ozone oxidation, photocatalytic oxidation)	<ul style="list-style-type: none"> <li>✓ Reduced volume</li> <li>✓ Reduced use of reagent</li> <li>✓ Low-cost</li> </ul>	2019	[17]

Photocatalytic purification cup	N-doped nano TiO <sub>2</sub> , tungsten-doped TiO <sub>2</sub> , WO <sub>3</sub> , graphene and C <sub>3</sub> N <sub>4</sub>	Photocatalytic emergency purification cup capable of purifying drinking water under the irradiation of sunlight or emergency light source, with a layer composed of photocatalytic microspheres and all-luminescence optical fibers	✓ ✓	Emergency purification device Improved light efficiency	2019	[18]
Magnetically condensed photocatalytic reactor	Photocatalyst: Ag <sub>2</sub> O, TiO <sub>2</sub> , ZrO <sub>2</sub> , CdS, C <sub>3</sub> N <sub>4</sub> or KBiO <sub>3</sub> , Magnetic core: CoFe <sub>2</sub> O <sub>4</sub> , NiFe <sub>2</sub> O <sub>4</sub> , ZnFe <sub>2</sub> O <sub>4</sub> , γ-Fe <sub>2</sub> O <sub>3</sub> or Fe <sub>3</sub> O <sub>4</sub>	The magnetic carrier is placed in the reaction bed to form a magnetic aggregation under the action of the magnetic source body	✓ ✓ ✓	Improved mass transfer Recycling of the catalyst Continuous operation	2018	[19]
Not specified	TiO <sub>2</sub> based photocatalyst	The device includes 5 or more photocatalytic units (Lamp and Photocatalytic fiber in parallel) connected in series and a biodegradation device connected in sequence	✓	Improved efficiency	2018	[20]
Dual-film photocatalytic reactor	Not specified	Dual-film photocatalytic reactor tank with membrane modules (inlet - intercept suspended particles and insoluble solids, outlet - separating the photocatalyst)	✓	Recycling of the catalyst	2018	[21]
Not specified	TiO <sub>2</sub> , nano ZnO, C <sub>3</sub> N <sub>4</sub> film layer	The main purpose of the present invention is to provide a continuous water treatment module (Day: sunlight; night: UV LED)	✓ ✓ ✓	Reduced loss of material Improved efficiency Continuous operation	2018	[22]
2 or more U-shaped photocatalytic reactors	g- C <sub>3</sub> N <sub>4</sub>	2 or more photocatalytic U-shaped chambers connected in sequence, with UV sources and a numerical control unit	✓ ✓	Improved efficiency Reduced volumes	2018	[23]
Not specified	Not specified	The device includes an ultrasonic generator, a pH meter probe and an ultraviolet spectrophotometer to real-time control	✓ ✓	Reduced reaction steps Self-cleaning	2017	[24]
Photocatalytic cylinders with photocatalytic plates	Not specified	The system comprises: (1) a pretreatment unit; (2) a photocatalytic device, with a first- and second-cylinder bodies (with a light-emitting device and several photocatalytic plates) ;(3) a post-processing unit	✓ ✓	Low-cost Low energy consumption	2019	[25]
Photocatalytic tank with TiO <sub>2</sub> coated nets	TiO <sub>2</sub> coating	The photocatalytic sterilizer for water treatment comprises a photocatalytic device with a controller and an ultraviolet ray generator (in the middle of the tank)	✓	Improved efficiency	2016	[26]
Not specified	TiO <sub>2</sub>	Reaction tank with a three-phase separator (located at the top of the tank)	✓ ✓	Recycling of the catalyst Improved efficiency	2019	[27]
Plate-shaped carrier/cylindrical photocatalytic reactor	Not specified	Series of UV sterilizer with control valve and flow regulating valve; the photocatalyst-loaded carrier is added to the UV sterilizer (structure independently installed and disassembled)	✓	Improved efficiency	2014	[28]
Not specified	Low iron oxide - TiO <sub>2</sub>	The visible-light photocatalytic reactor comprises a fiberglass sheet, and iron doped fibers	✓	Improved efficiency	2020	[29]
PEC	TiO <sub>2</sub> thin film as photocatalyst, Ta <sub>2</sub> O <sub>5</sub> -IrO <sub>2</sub> thin film as electrocatalyst	The invention includes a bifunctional electrode: a photocatalyst is applied to a portion of the surface and an electrocatalyst is applied to another portion of the surface	✓ ✓	Reduced e-h recombination Improved efficiency	2010	[30]
Not specified	Not specified	The photocatalytic device comprises a rotating composite media, on which the photocatalyst is coated, with parallel UV lamp	✓ ✓	Improved efficiency Self-cleaning	2010	[31]
Photocatalytic box with several UV rays	TiO <sub>2</sub> - coated	This device includes a box body with several UV rays located side by side. Along with the rays, several columns shaped (TiO <sub>2</sub> coated meshes) rotatable drums	✓	Improved efficiency	2010	[32]
Swirl-type photocatalytic reactor	TiO <sub>2</sub>	The reaction device includes an UV lamp tube provided with a rotating hood. The dry distillation sewage is introduced into the reaction tube along with O <sub>2</sub> , then are irradiated with intermittent lamp controlled by the rotation speed of the rotating hood	✓	Low cost	2010	[33]
PEC	TiO <sub>2</sub> film as supported catalyst; Graphite, Pt, Ti, RuO <sub>2</sub> , IrO <sub>2</sub> , or RuO <sub>2</sub> -Pt as anode; Ti, Pt, Fe, Al, Cu, or stainless steel as cathode	An electrochemical component and a photocatalytic component (Light source < 365 nm) disposed in the same reactor to cooperatively remove the organic matter in the water	✓	Improved efficiency	2010	[34]
PEC	TiO <sub>2</sub> nanotube array thin film as photoanode. Titanium or platinum based as photocathode	The photoelectrochemical reactor (for degradation of heavy metals such as Cr (VI)) includes several light sources located around the tank, as well as a TiO <sub>2</sub> photoanode and a counter electrode	✓ ✓	Improved efficiency Low cost	2010	[35]
Not specified	Nano TiO <sub>2</sub>	The car washing wastewater purification device is composed of a sewage container, a coarse filter connected to a quartz sand filter, photocatalytic oxidation device	✓	Improved efficiency	2010	[36]

Vertical continuous photocatalytic reactor	TiO <sub>2</sub> based, ZnO based or iron oxide-based filter paper	The device comprises a cylindrical structure, with an UV lamp (36 W U shaped) located in middle. The device includes a porous glass or wooden ceramic funnel, inclined 30° with respect to the lamp sleeve	✓ Recycling of the catalyst	2011	[37]
PEC	TiO <sub>2</sub>	A voltage is applied between the first electrode (on which the photocatalyst is supported), and the second electrode in contact with the flow of the water to be treated. Along with the voltage application, an UV irradiation is provided	✓ Low cost ✓ Improved efficiency	2011	[38]
PEC	Activate carbon TiO <sub>2</sub> loaded	The photocatalytic device is a cylindrical reactor with a conical bottom, a graphite electrode in the middle of the device, 8 UV lamps parallel to the electrode, and the photocatalyst is dispersed	✓ No loss of catalyst ✓ Improved mass transfer ✓ Improved efficiency ✓ Low energy consumption	2012	[39]
Microwave photocatalytic reactor	Not specified	The invention includes a square barrel-shaped (or Drum-shaped reactor); a microwave photocatalytic reaction chamber at the upper part (with 1 or more lamps) and (ii) an aeration chamber at the lower part	✓ Improved efficiency	2012	[40]
Not specified	Not specified	The device is composed of pre-treatment buffer tank, an anaerobic reactor, and a photocatalytic reactor (with UV lamp 200 – 280 nm). After the water quality monitoring, there is a water return system before the sewage lift pump	✓ Improved efficiency ✓ Longer life of the lamp tube	2012	[41]
Open photocatalytic reactor	TiO <sub>2</sub> layer	The present invention comprises an open circular water tank and a purple light with a protective cover fixed on the peripheral side of the tank	✓ Improved efficiency	2020	[42]
Laminated double helix photocatalytic reactor	Nano TiO <sub>2</sub> film	The invention provides a laminated double helix photocatalytic purifier suitable for high-concentration wastewater, including several rotating purification discs (horizontally installed -with photocatalyst coated), and UV LED light devices	✓ Improved efficiency ✓ Easy transport	2020	[43]
Photocatalytic reactor with dual band lamp	Not specified	The filtered wastewater is mixed with O <sub>2</sub> , then enters in the photocatalytic reactor (1 to 7 photocatalytic stages – with lamps 185 and 254 nm), then passes through the membrane catalytic reactor	✓ Longer life membrane ✓ Improved efficiency ✓ Low cost	2020	[44]
Swirling type photocatalytic reactor	TiO <sub>2</sub>	The invention comprises a cyclone type photocatalytic water purification device (UV lamp on the top), with a primary filter, a photocatalytic reactor and a final filter connected in sequence	✓ Improved efficiency	2020	[45]
Not specified	Not specified	The device includes a photocatalytic reaction chamber, with UV lamps fixed on the inner wall of the left side and three photocatalyst plates interspersed around the stirrer	✓ Simple operation ✓ Improved photon transfer	2020	[46]
Not specified	Not specified	The invention includes a turbulent adsorption chamber, a photocatalytic reaction chamber with UV light tube uniformly distributed along the chamber. The outer side of UV tube is provided of a curved reflector	✓ Improved efficiency	2020	[47]
Photocatalytic glass balls reactor	Not specified	The photocatalytic water purification fish tank includes a cylinder body and a water purification device; the photocatalytic devices are glass balls with a photocatalyst coating on the surface	✓ Improved efficiency	2020	[45]
Not specified	Not specified	The photocatalytic reaction chamber is equipped with several glass plates with interlayers, to form a serpentine flow channel. Several UV rays are placed in each glass plate interlayer	✓ Low cost ✓ Improved mass transfer	2020	[48]
Photocatalytic reactor coated with photocatalyst	TiO <sub>2</sub> coated on surface	A water treatment device (under direct sunlight) comprising a clear container with lid surrounded by a solar reflector, and a thin sheet or mesh insert coated with photocatalyst	✓ Improved efficiency	2020	[49]
Spiral photocatalytic reactor	Not specified	The invention comprises a spiral photocatalytic water purifier (with a cylindrical stainless-steel shell and an aluminium alloy spiral tube inside the shell, with photocatalyst coated), with an UV LED lamp	✓ Improved efficiency	2020	[50]
Not specified	TiO <sub>2</sub>	Reactor, an air inlet pipe, and an air pump, as well as an insulating plug, and a high-voltage electrode. TiO <sub>2</sub> balls and conductive beads are also provided in the reaction chamber, both not in contact with the nozzle electrode	✓ Improved efficiency	2020	[51]
Ozone photocatalytic reactor	Not specified	The model provides an ozone photocatalytic water purifier, including a body with an UV ozone photocatalytic reaction chamber, with several UV light tubes	✓ Low cost	2020	[52]

Photocatalytic reactor with filter plate	Not specified	The equipment includes a light source surrounded by a guide and a filter plate arranged between the inner wall of the processing box away from the discharge pipe	✓ ✓	Longer life of the lamp Improved efficiency	2020	[53]
Plane spiral shape photocatalytic reactor	Not specified	Photocatalytic board (plane spiral shape), and plates installed on the photocatalytic board. The plates are made of light-transmitting material, with light source fixed on the outer wall of the pipe	✓ ✓	Improved efficiency Reduced loss of catalyst	2020	[54]
PEC	TiO <sub>2</sub> wire	Catalytic chamber, graphite sheet, and a photoelectric catalytic net (vertically arranged, with several UV lamps). TiO <sub>2</sub> wire rotating shaft (connected with the positive electrode), graphite sheet (connected with the negative electrode)	✓ ✓	Improved efficiency Low cost	2020	[55]
Swirling photocatalytic reactor	Aluminium alloy with photocatalytic film and carbon filter	The photocatalytic reactor adopts the swirling flow technology. The aluminium alloy tube (with a photocatalytic film loaded), and the activated carbon filter cooperates with the photocatalytic reaction	✓ ✓	Low energy consumption Improved efficiency	2013	[56]
Not specified	TiO <sub>2</sub>	Photocatalytic wastewater tank with pH adjuster to precipitate the photocatalyst	✓	Improved efficiency	2013	[57]
Not specified	Carbon fiber coated with ZnO	The device includes a purification processor, a water pump, a water pipe, and a liquid container. The UV lamp is placed on the upper layer of the purification processor	✓	Improved efficiency	2013	[58]
Not specified	Nano TiO <sub>2</sub> loaded on honeycomb ceramic mesh	The device includes a tank body, a quartz tube, backflow interface, super UV lamp tube (150-280 nm) three-dimensional honeycomb ceramic mesh photochemical reaction chamber	✓	Improved efficiency	2013	[59]
Horizontal photomagnetic reactor	TiO <sub>2</sub>	The device includes a horizontal photocatalytic reactor with honeycomb ceramic mesh components and ultraviolet lamp assembly, a magnetic separator and a magnetic flocculant return pump	✓	Simple operation	2013	[60]
Ultrasonic photocatalytic reactor	Not specified	The invention comprises an UV lamp and an ultrasonic component; a ring-shaped quartz glass is installed in the water treatment chamber, and the photocatalytic metal mesh is installed in the adjacent ring-shaped quartz glass	✓ ✓ ✓	Improved efficiency Simple operation Low energy consumption	2013	[61]
Photocatalytic horizontal tank with membrane	TiO <sub>2</sub>	The photocatalytic horizontal tank comprises a UV lamp, activated carbon tubes (coated with TiO <sub>2</sub> )	✓	Reduced mineral loss	2013	[62]
Series of staggered photocatalytic tank	Not specified	Series of photocatalytic unit in staggered position forming S flow path. Each photocatalytic unit comprises a filtering net, a mirror panel, and a light source	✓ ✓	Low energy consumption simple operation	2014	[63]
Two-zone dual film photocatalytic reactor	Not specified	The invention provides an internal space divided by a quartz glass tube into a photocatalytic short, medium wave reaction zone and a photocatalytic long wave reaction zone, with the membrane are loaded with photocatalyst	✓ ✓	Simple structure Improved efficiency	2016	[64]
Spiral photocatalytic reactor	Not specified	A cylindrical ultraviolet reactor shell comprising an UV sensor to control light intensity with photocatalyst-loaded helical carrier	✓ ✓ ✓	Improved photon transfer High turbulence Improved efficiency	2016	[65]
Cover plate photocatalytic reactor	Not specified	The invention provides a reactor body and a concave cover plate with a glass interlayer. The reactor body is provided with an outwardly extending horizontal edge	✓	Simple operation	2016	[66]
Self-rotating photocatalytic reactor	TiO <sub>2</sub>	The device comprises nanotube-type photocatalysts immobilized on solar-irradiated titanium supports are self-rotating. The device allows the degradation of Cr(VI) and bisphenol in the presence of endocrine disrupting compounds	✓	Simultaneous degradation of Cr (VI) and bisphenolA	2015	[67]
Plate-like/spiral sheet-like photocatalytic rotating reactor	Not specified	The rotating device comprises a plate-like structure or a spiral sheet-like structure, with the UV lamp immersed in the water. The tank is coated with photocatalytic material	✓	Improved efficiency	2015	[68]
Wave-shaped quartz photocatalytic reaction tube	Triangular TiO <sub>2</sub> coating	The device is provided of a height-adjustable support, a split frustoconical holder, and wave-shaped quartz photocatalytic reaction tube, coated with a triangular titanium dioxide coating. The front of the device is provided of a viewing window	✓ ✓ ✓	Reduced volume Low cost Improved efficiency	2018	[69]
Cylindrical photocatalytic reactor	Not specified	The water purifier body includes a cylindrical shell, 4 photocatalytic modules with UV lamps and optical guide medium	✓ ✓	Reduced energy consumption Improved efficiency	2017	[70]

Visible active photo reactor with layers	graphene photocatalytic network	The visible light active device includes at least a layer of photocatalytic net arranged in tank, a series of light source (supplementary) and a filter screen	✓ Improved efficiency ✓ Low energy consumption	2017	[71]
Photocatalytic pool	Titania-loaded zeolite	The device includes a flocculation tank, an activate carbon filter layer and a photocatalytic pool with UV lamps	✓ Low energy consumption	2017	[72]
Photocatalytic microreactor	TiO <sub>2</sub> film	The invention provides a photocatalytic microreactor with titanium coated optical fibers	✓ Improved mass and photon transfer ✓ No loss of catalyst	2012	[73]
Photocatalytic microreactor	Metal doped TiO <sub>2</sub>	The invention comprises a plate type photocatalytic microreactor, with the light source located on the top of the plate	✓ Low energy consumption ✓ Reduced e-h recombination ✓ Reduced loss of catalyst	2014	[74]
Photocatalytic microreactor	MOFs	The device comprises a microchannel with grafted photocatalytic nanostructures	✓ Improved photon transfer ✓ Low cost	2020	[75]
PEC	Titanium sheet and a titanium oxide layer as electrode	The device includes a floating plate, a photoelectric conversion component fixedly mounted on the floating plate and is electrically connected to the positive electrode and the negative electrode of the photoelectric conversion component (1 or more solar cells arranged in series	✓ Improved efficiency ✓ Low cost	2020	[76]

**Table S2.** Summary of the most significant patent reviewed in the field of photocatalytic air treatment (2010 – 2020).

Type of reactor	Photocatalyst	Brief description	Advantages	Year	Reference
Not applicable	TiO <sub>2</sub> + cyclodextrin	Wallpaper for indoor air purification under natural light	✓ Natural light ✓ Low maintenance ✓ Part of room decoration	2010	[77]
Device	TiO <sub>2</sub> / ZnO / Sn <sub>2</sub> O <sub>3</sub> / ZrO <sub>2</sub>	Filter + water spray + ultrasonic generator + UV photocatalytic unit + secondary filter	✓ Water improved catalysis	2014	[78]
Fluidized bed	Activated carbon + TiO <sub>2</sub>	Fluidized bed of TiO <sub>2</sub> loaded activated carbon particles under UV irradiation	✓ Fluidized state improves contact ✓ Activated carbon improves adsorption	2013	[79]
Device for air conditioner	TiO <sub>2</sub>	Filter net + photocatalytic unit + UV light source	✓ Integrated in pre-existing air conditioner	2014	[80]
Device	TiO <sub>2</sub>	Filter + photocatalytic unit + UV lamp + fan	✓ Increased surface and air flow	2014	[81]
Air duct type	TiO <sub>2</sub>	Tubular device, the W shaped catalyst is placed around the UV lamp	✓ Increased surface ✓ Integrated in pre-existing air duct	2014	[82]
Device	TiO <sub>2</sub>	NAI + photocatalytic unit + UV light + filter + fan	✓ NAI improves efficiency ✓ Washable filter	2015	[83]
Device	Activated carbon + TiO <sub>2</sub>	Activated carbon filter + LED + photocatalytic unit	✓ Safe and energy saving LEDs	2015	[84]
Device	Ag/TiO <sub>2</sub>	Photocatalytic unit + UV lamps	✓ Ag doping improves efficiency ✓ Activated carbon improves adsorption	2015	[85]
Device	Activated carbon + TiO <sub>2</sub>	Fan + photocatalytic unit + UV lamps + activated carbon net	✓ Activated carbon improves adsorption	2015	[86]
Device	Activated carbon + TiO <sub>2</sub>	Filter + Multichannel photocatalytic unit coated with TiO <sub>2</sub>	✓ Activated carbon improves adsorption ✓ Low pressure drops	2016	[87]
Device	Activated carbon + not specified catalyst	Humidifier + ultrasonic generator + photocatalytic unit + UV light source	✓ Humidification integrated in the device	2016	[88]
Not applicable	Not applicable	A test method for air purifiers + a device to adjust air parameters + analytics	✓ Air parameters can be precisely adjusted for fair test comparisons ✓ Integrated analytics	2016	[89]

Tubular reactor	Not specified	Tubular reactor with annular photocatalytic unit with vent holes and UV lamps	✓ Vent holes improve efficiency ✓ Can be integrated on pre-existing pipes	2016	[90]
Device	Not specified	Small device for portable applications and cars with UV LEDs	✓ Reduced noise ✓ Compactness ✓ Safer light source	2016	[91]
Device	Several metal-doped semiconductors are proposed	Photocatalytic material is deposited on transparent carrier particles surrounding the lamps	✓ Better utilization of irradiated light ✓ Increase in temperature improves efficiency ✓ Ozone removal	2017	[92]
Device	TiO <sub>2</sub>	Dust filter + activated carbon filter + HEPA filter + NAI + oxygen generator + photocatalytic unit fragrance sheet	✓ Good air filtration ✓ Oxygen improves efficiency	2017	[93]
Device	Not specified	Primary filter + activated carbon filter + electrostatic dust remover + photocatalytic unit with UV lamps + fan and HEPA filter	✓ Good air filtration	2017	[94]
Tubular reactor	TiO <sub>2</sub> or WO <sub>3</sub>	Tubular photocatalytic reactor with baffles for improved local turbulence	✓ Improved contact between phases	2017	[95]
Device	Not specified	Internal deflectors and commutators to increase contact time	✓ Improved contact between phases	2018	[96]
Device	Doped-TiO <sub>2</sub>	Filters + activated carbon + Photocatalytic unit + UV and visible LEDs + NAI + fan	✓ Visible light adoption ✓ LEDs adoption	2018	[97]
Device	Ag/TiO <sub>2</sub>	Compact device with composite photocatalytic material	✓ Compactness	2018	[98]
Device	Not specified	Dust trap chamber + photocatalytic unit	✓ Dust is collected in a separate chamber	2018	[99]
Device	Not specified	Photo-electrolytic device with electrolytic aqueous solution	✓ Electro-catalysis improves efficiency	2018	[100]
Device	Not specified	Photocatalytic device with embedded sensors and IoT	✓ Monitoring and automated activation	2018	[101]
Not applicable	Pigment-modified TiO <sub>2</sub>	Coating material for activation under visible light for indoor air purification	✓ Visible light	2019	[102]
Device	Not specified	Catalytic supports are baffles that create local turbulence + reflective device	✓ Improved contact between phases ✓ Improved light utilization	2019	[103]
Device	Not specified	Vibrating activated carbon filter + photocatalytic device with reflective walls	✓ Improved dust removal ✓ Improved light utilization	2019	[104]
Tubular reactor	Not specified	Series of cheap primary filters + tubular photocatalytic reactor with fins to increase contact	✓ Improved contact between phases ✓ Cheaper dust filter replacement	2019	[105]
Device	TiO <sub>2</sub>	Filter + inclined photocatalytic unit to avoid dust accumulation + detectors	✓ Automated activation ✓ Decrease in accumulated dust	2019	[106]
Device	TiO <sub>2</sub>	Filter + photocatalytic unit with corrugated surface + detectors	✓ Monitoring of pollutants concentration ✓ Increased surface available	2020	[107]
Device	Not specified	Adsorption module + photocatalytic unit + NAI. Adsorption and photocatalytic module are electrically connected	✓ Increased efficiency	2020	[108]
Device	TiO <sub>2</sub>	Photocatalytic water trickle bed + UV lamp + oxygen enricher + adsorption + filter	✓ Increased efficiency by water and oxygen enrichment	2020	[109]
Device	TiO <sub>2</sub>	TiO <sub>2</sub> are dispersed on polymeric fibres + UV lamp	✓ Reduced nano-particle catalyst loss	2020	[110]
Device	TiO <sub>2</sub>	Activated carbon filter + series of corrugated catalytic plates alternated with UV lamps	✓ Increase in surface	2014	[111]
Device	Melamine-modified TiO <sub>2</sub>	Activated carbon filter + photocatalytic unit with modified TiO <sub>2</sub> + visible light LEDs + HEPA filter	✓ Visible light ✓ Safer and more efficient LEDs	2014	[112]
Device	Graphitic carbon nitride g-C <sub>3</sub> N <sub>4</sub>	Filter + spiral photocatalytic unit + visible light LEDs	✓ Visible light ✓ LEDs ✓ Increase in contact time	2014	[113]
Tubular reactor	Not specified	Electrified tubular photocatalytic unit	✓ Integrated on pre-existing duct	2014	[114]
Device for air conditioner	Doped TiO <sub>2</sub> (Cu, Ag, Fe, Co, Ni, Tb, or Eu)	Method for material preparation and deposition on quartz sleeves of UV lamp to integrate in air conditioners	✓ Integration in pre-existing air conditioner	2015	[115]
Tubular reactor	TiO <sub>2</sub>	Carrier elements attached to a rotating UV lamp	✓ No fan needed	2015	[116]

			✓ Improved contact between phases		
Device	TiO <sub>2</sub>	NAI + series of photocatalytic units alternated with UV lamps + secondary filter	✓ Filter are disinfected by the UV light ✓ Increased surface	2015	[117]
Device	Not specified	Filtration box + 3 photocatalytic modules alternated with UV lamps	✓ Increased surface ✓ Modularity	2015	[118]
Device	TiO <sub>2</sub> /Ti + TiO <sub>2</sub> /ACF (activated carbon fiber)	Filter + 3 layers of photocatalytic materials in parallel + UV lamps	✓ Improved efficiency	2015	[119]
Device for air conditioner	Ag/TiO <sub>2</sub>	Modified TiO <sub>2</sub> material with LEDs (100- 400 nm)	✓ Integrated in pre-existing air conditioner ✓ Improved efficiency	2015	[120]
Photocatalytic washable filter	TiO <sub>2</sub>	Photocatalytic filter and preparation method	✓ The photocatalyst can be washed in boiling water	2016	[121]
Device	TiO <sub>2</sub> , Bi <sub>2</sub> O <sub>3</sub> , and a third non-metallic photocatalytic layer	Photocatalytic unit consisting of three layers of material and visible light source. Designed for cars	✓ Compactness ✓ Visible light	2017	[122]
Face Mask	N-TiO <sub>2</sub> , bismuth oxycarbonate, bismuth oxychloride, and/or carbon nitride	Face mask with photocatalytic filter of consecutive layers and light transmission module	✓ Visible light ✓ Compactness	2017	[123]
Device	Not specified	Photocatalyst carrier consist of several elements place around the central UV lamp inclined at 80°	✓ Increased surface	2017	[124]
Device	TiO <sub>2</sub> + N-TiO <sub>2</sub> +lanthanide oxide + non-metal photocatalytic material	Filter + photocatalytic unit active under visible light	✓ Visible light	2018	[125]
Device	Not specified	Chemical filtration + filter + photocatalytic unit	✓ Chemical filtration can remove pollutants deriving from specific applications	2019	[126]
Device	TiO <sub>2</sub>	Filters + water spray chamber + photocatalytic unit + ozone filter	✓ Atomized water improves efficiency ✓ Atomized water reflects light	2019	[127]
Tubular online reactor	TiO <sub>2</sub>	Tubular reactor with UV lamp along the axis and corrugated catalytic surface around it	✓ Integrated in pre-existing pipe ✓ Increased surface	2019	[128]
Device	Not specified	Magnetic field + NAI + photocatalytic unit + wireless communication and monitoring module	✓ Automated monitoring and activation ✓ Improved efficiency	2019	[129]
Device	Activated carbon + TiO <sub>2</sub>	The photocatalytic unit consists of acrylic fibers with dispersed activated carbon and nano-TiO <sub>2</sub>	✓ Improved efficiency ✓ Increased surface	2020	[130]
Device	Zn/Cu/TiO <sub>2</sub>	Metallic plates covered in copolymer for adhesion of the catalytic doped TiO <sub>2</sub> material + UV lamps	✓ Reduced catalyst losses ✓ Increased surface	2016	[131]
Bed frame	TiO <sub>2</sub>	Bed frame with TiO <sub>2</sub> and UV lamps for bedroom air purification	✓ Integration in room decoration	2017	[132]
Device	Not specified	Photocatalytic module and HEPA filter alternated with UV lamps	✓ HEPA filters are disinfected by UV lamps	2018	[133]
Device	TiO <sub>2</sub>	Module with 4-10mm gap between the photocatalytic plates + vortex generator	✓ Compactness ✓ Improved contact between the phases	2019	[134]
Device	TiO <sub>2</sub>	Spiral photocatalytic unit with TiO <sub>2</sub> and UV LEDs	✓ Improved contact between the phases ✓ Increased contact time ✓ Safer LEDs technology	2013	[135]
Not applicable	Supported (porous oxide) doped (metal) semiconductor (TiO <sub>2</sub> , WO <sub>3</sub> , ZnO, ecc)	Preparation method for a supported doped material that can be used in photocatalytic filters	✓ Easy preparation ✓ Visible light	2019	[136]
Device	TiO <sub>2</sub>	HEPA filter + hexagonal photocatalytic cells + UV light source	✓ Compactness ✓ Low pressure drop	2020	[137]
Device for car air conditioner	TiO <sub>2</sub>	Supported TiO <sub>2</sub> with UV LEDs	✓ Integration in pre-existing air conditioner	2020	[138]

			<ul style="list-style-type: none"> <li>✓ Compactness</li> <li>✓ UV light can also disinfect air conditioner evaporators</li> </ul>		
Device for air conditioner	TiO <sub>2</sub> /WO <sub>3</sub> /ZnO	Photocatalytic chamber with different semiconductors and light sources with $\lambda < 400$ nm	<ul style="list-style-type: none"> <li>✓ Visible light</li> <li>✓ Integration in pre-existing air conditioner</li> </ul>	2013	[139]
Device	TiO <sub>2</sub> + WO <sub>3</sub> + Fe	Photocatalytic unit consisting of square cells supporting the material	<ul style="list-style-type: none"> <li>✓ Improved efficiency</li> </ul>	2018	[140]
Device for the fridge	TiO <sub>2</sub>	Supported TiO <sub>2</sub> with minimal distance from UV LEDs (25-40 mm)	<ul style="list-style-type: none"> <li>✓ Compactness</li> </ul>	2019	[141]
Device	Not specified	Elements are placed to reduce pressure drops, UV lamps with varying power depending on the level of pollutants, reflective walls	<ul style="list-style-type: none"> <li>✓ Reduced pressure drops</li> <li>✓ Reduced energy consumption</li> <li>✓ Improved light utilization</li> </ul>	2011	[142]
Device	Many doped composite are proposed	Device with UV and visible light sources for better light utilization, independent use of the lamps depending on the need	<ul style="list-style-type: none"> <li>✓ Improved efficiency</li> <li>✓ Save energy</li> </ul>	2016	[143]
Device for cars	TiO <sub>2</sub>	Photocatalytic module with UV LEDs at short distance from the photocatalytic material	<ul style="list-style-type: none"> <li>✓ Compactness</li> <li>✓ LEDs adoption</li> </ul>	2016	[144]
Tubular device	ZnO, Cu <sub>2</sub> O, Fe <sub>2</sub> O <sub>3</sub> , CdS, GaP, ZnS, WO <sub>3</sub> , or others	Tubular quartz glass or UV transparent material supporting the catalyst and the UV lamps, reflective walls	<ul style="list-style-type: none"> <li>✓ Improved efficiency</li> <li>✓ Reduced pressure drop</li> </ul>	2019	[145]

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