PHOTOCATALYSIS AND ELECTROCATALYSIS APPLIED TO WATER DECONTAMINATION

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ABSTRACT

PURIFICATION AND FILTRATION OF WATER FOR DRINKING PURPOSES, SUCH AS THROUGH NANOSCALE MEMBRANES OR USING NANOSCALE POLYMER "BRUSHES" COATED WITH MOLECULES THAT CAN CAPTURE AND REMOVE POLLUTANT AS CAN BE: POISONOUS METALS, PROTEINS AND GERMS.

ABSTRACT

NANOMATERIALS HAVE UNIQUE SIZE-DEPENDENT PROPERTIES RELATED TO THEIR HIGH SPECIFIC SURFACE AREA. NANO-BASED CHARACTERISTICS ALLOW THE DEVELOPMENT OF NOVEL HIGH-TECH MATERIALS FOR MORE EFFICIENT WATER AND WASTEWATER TREATMENT PROCESSES, NAMELY MEMBRANES, ADSORPTION MATERIALS, NANOCATALYSTS, FUNCTIONALIZED SURFACES, COATINGS, AND REAGENTS.

ADSORPTION

THE MAIN PROPERTY OF THE NANOMATERIALS IS THE ADSORPTION, THE CAPABILITY OF ALL SOLID SUBSTANCES TO ATTRACT TO THEIR SURFACES MOLECULES OF GASES OR SOLUTIONS WITH WHICH THEY ARE IN CLOSE CONTACT.

DUE TO THEIR HIGH SPECIFIC SURFACE AREA, NANOADSORBENTS SHOW A CONSIDERABLY HIGHER RATE OF ADSORPTION FOR ORGANIC COMPOUNDS COMPARED WITH OTHER KIND OF USED MATERIALS.

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ELECTROCATALYSIS

ELECTROCATALYSIS IS A PROCEDURE OF CATALYSIS IN ELECTROCHEMICAL REACTIONS; THE CATALYTIC EFFECT OF AN ELECTRODE ON A REACTION TAKING PLACE AT ITS SURFACE; ALSO THE INVESTIGATION OF ELECTRODE MATERIALS WITH A VIEW TO INCREASING THE RATE OF AN ELECTROCHEMICAL REACTION.

ELECTROCATALYSIS

THE PRINCIPAL ADVANTAGE OF THIS TECHNOLOGY IS ITS ENVIRONMENTAL COMPATIBILITY, DUE TO THE FACT THAT IT INVOLVES THE USE OF A VERY CLEAN REAGENT, THE ELECTRON. OTHER ADVANTAGES ARE RELATED TO ITS VERSATILITY, HIGH ENERGY EFFICIENCY, AMENABILITY TO AUTOMATION, AND SAFETY BECAUSE IT IS OPERATED AT MILD CONDITIONS.

ELECTROCATALYSIS

THERE ARE TWO WAYS OF DECONTAMINATION:

1.DIRECT ANODIC OXIDATION WHICH YIELDS VERY POOR DECONTAMINATION.

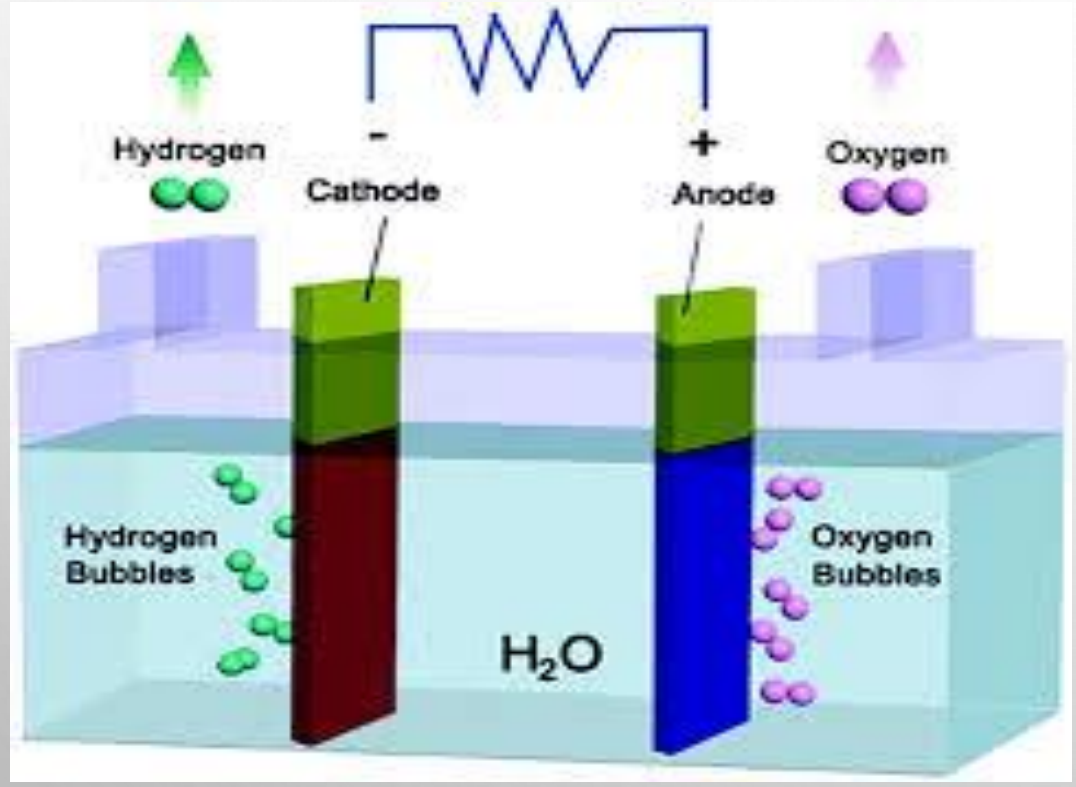
2.CHEMICAL REACTION WITH ELECTROGENERATED SPECIES FROM WATER DISCHARGE AT THE ANODE

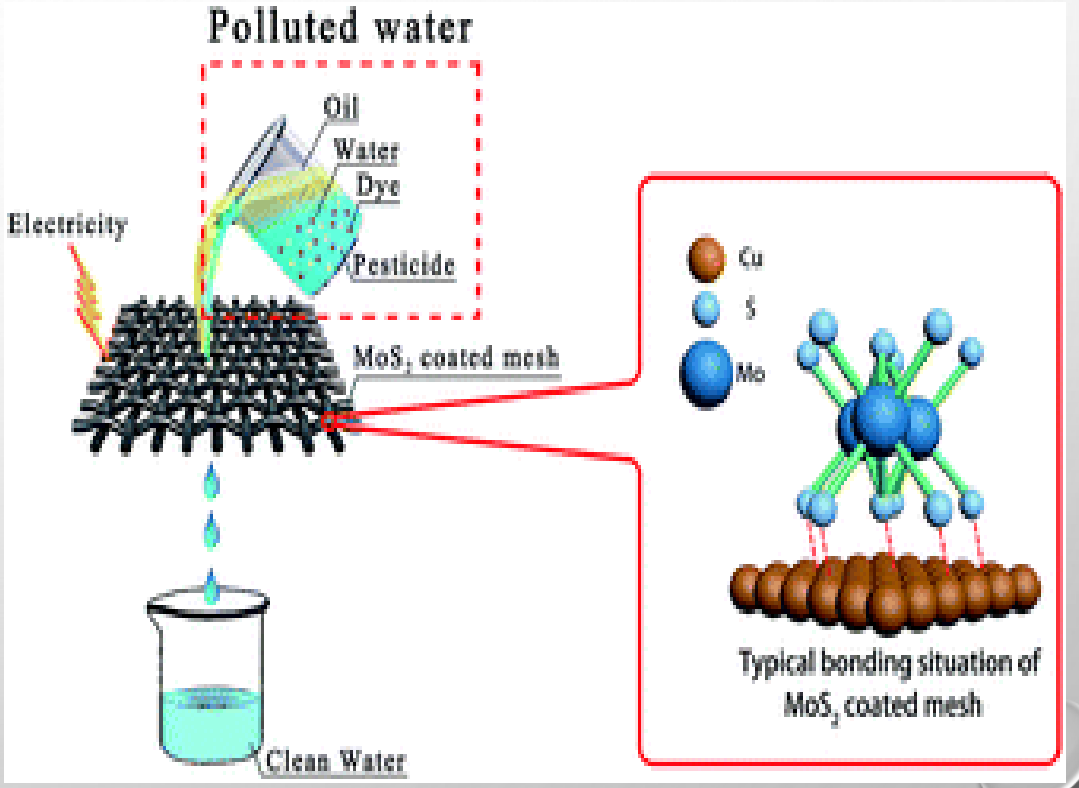
ELECTROCATALYSIS

ELECTRODE MATERIAL FOR THE DEGRADATION OF ORGANIC POLLUTANTS SHOULD BE TOTALLY STABLE IN THE ELECTROLYSIS MEDIUM, INEXPENSIVE, AND HIGHLY ACTIVE TOWARDS ORGANIC OXIDATION WHILE LOWLY ACTIVE TOWARDS SECONDARY.

ACTIVE ANODES, WHICH PRESENT LOW OXYGEN EVOLUTION OVERPOTENTIAL, ARE GOOD ELECTROCATALYSTS, IT PRODUCES SELECTIVE OXIDATION OF THE ORGANIC POLLUTANTS.

ELECTROCATALYSIS





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PHOTOCATALYSIS

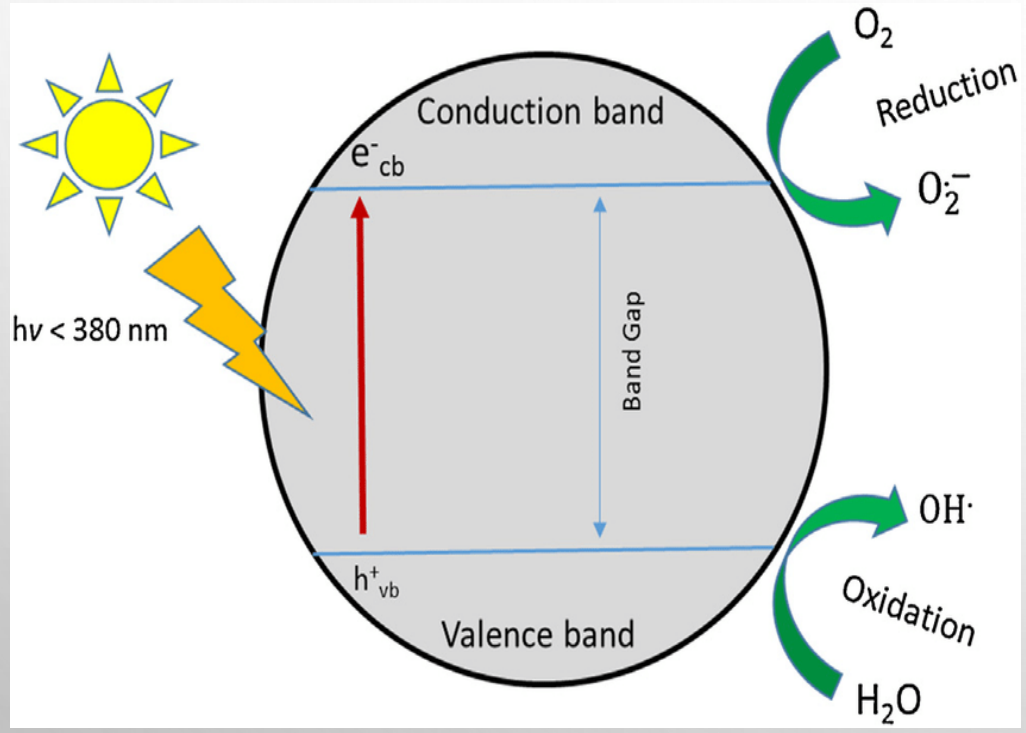
PHOTOCATALYSIS IS THE ACCELERATION OF A PHOTOREACTION IN THE PRESENCE OF A CATALYST. IN CATALYZED PHOTOLYSIS, LIGHT IS ABSORBED BY AN ADSORBED SUBSTRATE. INVOLVES THE USE OF A SEMI-CONDUCTING MATERIAL WHICH CAN BE EXCITED BY THE ABSORPTION OF LIGHT.

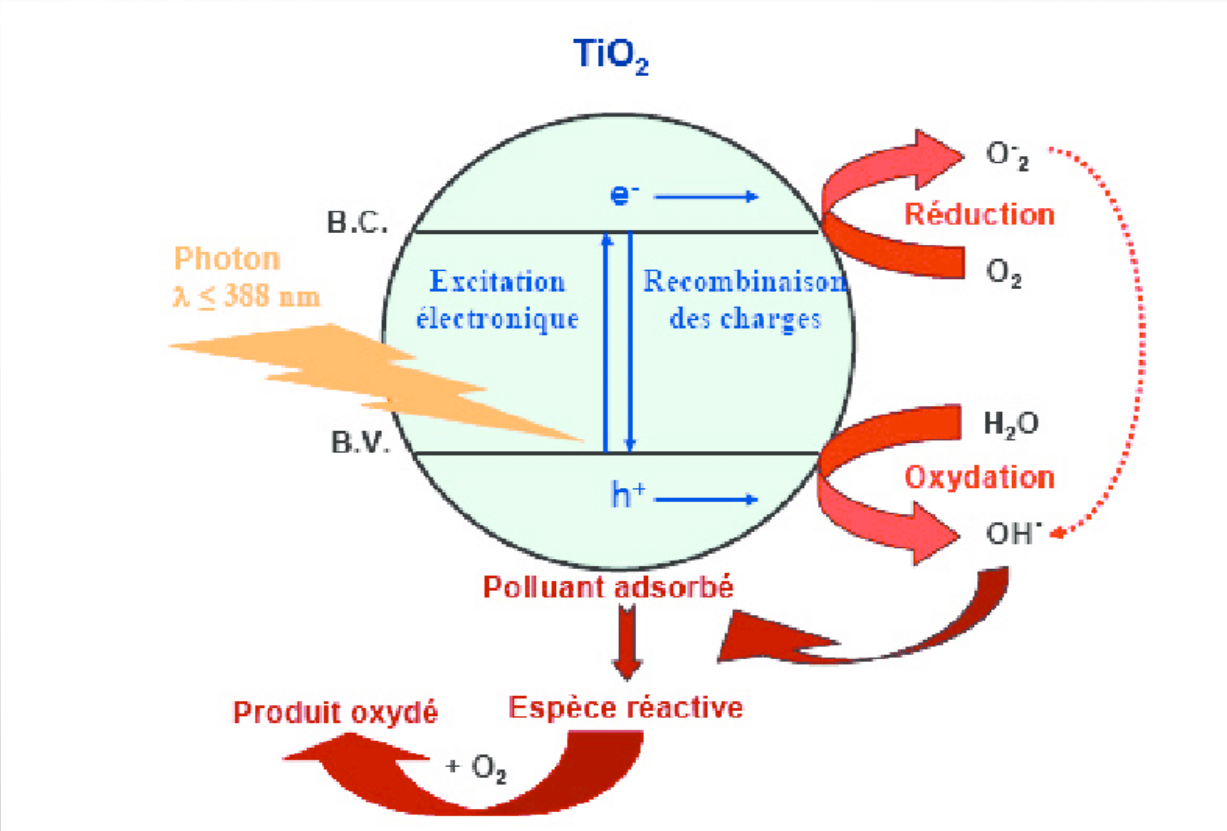
PHOTOCATALYSIS

THE IMPORTANT PROPERTIES OF THESE MATERIALS INCLUDE THE BAND GAP ENERGY AND HENCE THE WAVELENGTH OF LIGHT REQUIRED FOR EXCITATION, THE CHEMICAL AND PHOTOCHEMICAL STABILITY, PARTICLE SIZE AND SURFACE AREA.

THE MOST COMMONLY EMPLOYED PHOTOCATALYST MATERIAL FOR RESEARCH AND INDUSTRIAL APPLICATIONS IS TITANIUM DIOXIDE (TiO_2). THIS IS BECAUSE IT IS PHOTOSTABLE, CHEMICALLY STABLE, PHOTOACTIVE, RELATIVELY INEXPENSIVE AND NON-TOXIC.

PHOTOCATALYSIS





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LIMITATIONS

COMMERCIALIZATION OF NANOENGINEERED MATERIALS FOR WATER AND WASTEWATER TECHNOLOGY STRONGLY DEPENDS ON THEIR IMPACT ON THE AQUEOUS ENVIRONMENT. NUMEROUS STUDIES INCLUDING TOXICITY TESTS, LIFE CYCLE ANALYSIS, TECHNOLOGY ASSESSMENT, AND PATHWAYS AND DISPERSAL OF NANOPARTICLES IN WATER BODIES HAVE BEEN CARRIED OUT IN ORDER TO EVALUATE THE HEALTH RISKS OF NANOMATERIALS

LIMITATIONS

MATERIALS THAT FUNCTIONALIZED WITH NANOPARTICLES INCORPORATED OR DEPOSITED ON THEIR SURFACE HAVE RISK POTENTIAL, SINCE NANOPARTICLES MIGHT RELEASE AND EMIT TO THE ENVIRONMENT WHERE THEY CAN ACCUMULATE FOR LONG PERIODS OF TIME.

REFFERENCES

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