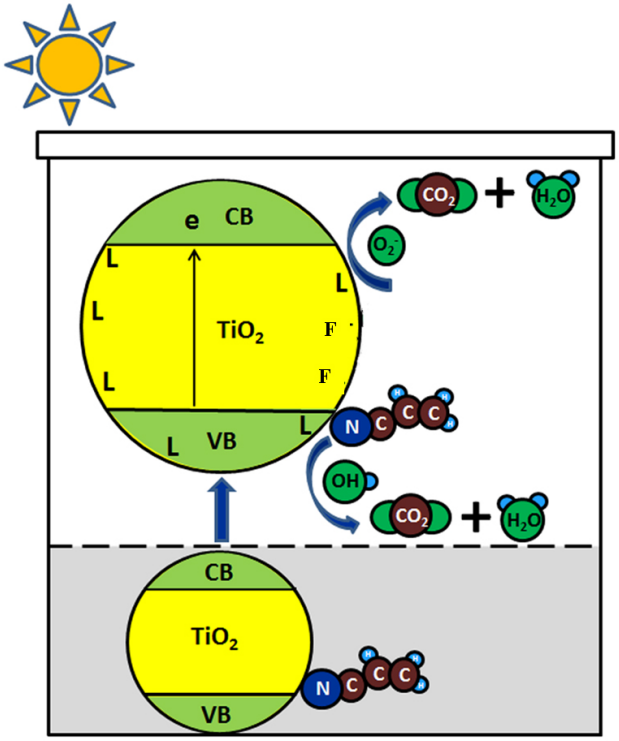
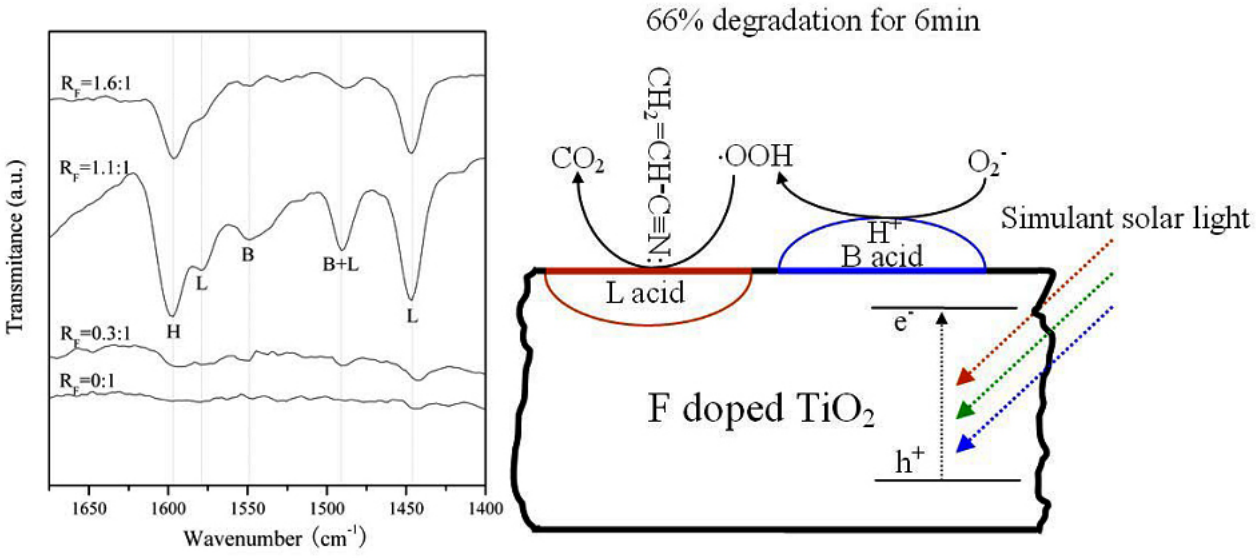
A new way for use of solar light in wastewater treatment



Acrylonitrile (CH_2=CH-CN) is generally considered as hazardous pollutant since it is mutagenic, carcinogenic and teratogenic to human health. Traditional control technologies of acrylonitrile include adsorption and desorption, thermal and catalytic incineration at high temperatures and biotechnological abatement methods. However, it has many limitations like high operating costs, secondary waste stream problems and so on. Therefore, developing an alternative abatement method attracts increasing interests.

Photocatalytic oxidation has been an effective alternative remediation technology due to the thermal stability, facile synthesis, low cost and the low toxicity of TiO_2. Recently, TiO_2 has been the most widely used photocatalyst due to its property of conversion from UV light to chemical energy to decompose most of organic pollutants that exist in air and aqueous systems or generate hydrogen from water. The general drawbacks of photocatalytic oxidation, for instance, low reaction rates, remain to improve. The photocatalytic activity of TiO_2 can be promoted by the addition of SiO_2 which increases the available surface area of the catalyst. Another potentially effective way to improve the photocatalyst performance is to increase the number of surface acid sites because the photocatalytic activity may enhance through the acidification of catalyst surface. Doping TiO_2 with metal oxides was reported to increase the surface acidity and photocatalytic activity of TiO_2. Sulfated TiO_2 can be readily synthesized by the reaction of amorphous TiO_2 with a source of sulfur compounds at high temperatures and employed as photocatalysts.



To study the photodcatalytic degradation of acrylonitrile on the acid catalysts, we prepared F doped TiO_2/SiO_2 composite oxide solid acid catalyst and found that catalyst have high activity for the oxidative degradation, which can reach to 66% after reaction for 6 min under simulant solar light. The effectiveness of photocatalytic degradation of acrylonitrile with F doped TiO_2/SiO_2 is attributed to increase of acidity of the catalyst. Bronsted and Lewis acid sites appear on the surface of the sample after F doping and they play a crucial role in promoting photocatalytic activity. The rapid degradation shows that our catalyst is promised for application under solar light, which unlocks a new way for use of solar light in wastewater treatment. Solar light is an inexhaustible energy. This finding will cause an important impact on the application of sunlight.

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Publications

Photocatalytic decomposition of acrylonitrile with N-F codoped TiO2/SiO2 under simulant solar light irradiation.
Pang D, Qiu L, Wang Y, Zhu R, Ouyang F
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Fluorine promoted and silica supported TiO2 for photocatalytic decomposition of acrylonitrile under simulant solar light irradiation
Dandan Pang, Yunteng Wang, Xiaodong Ma, Feng Ouyang
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