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SUNLIGHT CONVERTS WASTE PLASTIC TO HYDROGEN FUEL

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ABSTRACT:

Solar-driven reforming of plastics offers a simple and low-energy means to turn waste into H2. Here, we report the efficient photoreforming of three commonly produced polymers – polylactic acid, polyethylene terephthalate (PET) and polyurethane – using inexpensive CdS/CdOx quantum dots in alkaline aqueous solution. This process operates under ambient temperature and pressure, generates pure H2 and converts the waste polymer into organic products such as formate, acetate and pyruvate. We further validate the real-world applicability of the system by converting a PET water bottle into H2. This is the first demonstration of visible light-driven, noble metal-free photoreforming of plastic.

Keywords-CdS, Plastic waste, photoreforming

1.INTRODUCTION

Plastic eventually begins to break down when it is immersed in water and exposed to sunlight, but this process can take hundreds of years. The researchers were able to speed up this reaction by using a photocatalyst that harnesses the energy in sunlight. The process, known as photoreforming, can break down water to pure hydrogen fuel and plastic to useful small molecules within hours.

Photoreforming of simple alcohols to produce hydrogen has been researched extensively, but this process is too costly for industrial hydrogen production. Instead, the team used waste plastics as an abundant and inexpensive alternative to alcohols. The problem is that plastics are more challenging to reform because of their complex structures, low water solubilities and poor biodegradability.

To reform the plastics, researchers developed a photocatalyst made of inexpensive cadmium sulphide quantum dots mixed into an alkaline water solution. The dots are no bigger than five nanometers in diameter – 100,000

times smaller than the diameter of a human hair – which gives them an enormous amount of surface area, making the catalyst extremely efficient.

The resulting catalyst solution was applied to three commonly-used plastics: polylactic acid (PLA), polytheylene terephthalate (PET), and polyurethane (PUR). The researchers then irradiated the plastic mixture with sunlight, allowing the catalyst to reduce water from the solution to hydrogen and simultaneously oxidise the plastic to small organic molecules. The entire process can be done at ambient (room) temperature, which contributes to its cost-effectiveness.

2.MATERIALS REQUIRED

1.CdS-cadmium sulphide quantum dots as catalyst

Figure 1 CdS Quantum dots

2.Alkaline aqueous solution

3.Polymeric plastic-polylactic acid, polyethylene terephthalate, polyurethane

Figure 2 Polylactic acid plastic

3.PROCEDURE

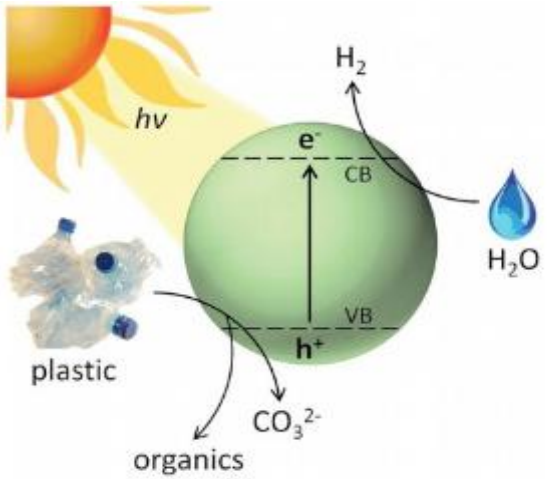
1.The catalyst is put onto the plastic.

2.Then the plastic is put into a "test tube" containing a concentrated solution of sodium hydroxide (lye).

3.The tube is put in the sun.

4.The plastic decomposes into small organic molecules and hydrogen is generated.

A diagram tells us what is going on at the atomic level. Sunlight strikes the cadmium sulfide which causes the ejection of a high energy electron. The electron reacts with water to produce hydrogen gas and also degrades the plastic to produce small fragments (depending on the plastic) of benign organic chemicals such as lactic acid, acetic acid, and alcohol.



4.ADVANTAGES

1.The use of hydrogen greatly reduces pollution. The advantage of using hydrogen as an energy carrier is that when it combines with oxygen the only byproducts are water and heat. No greenhouse gases or other particulates are produced by the use of hydrogen fuel.

2.Other methods for degrading recycled plastic are sensitive to food residues that are inevitably found in plastic waste.

3.Helps to solve the recycling problem of plastic.

4.Recycles energy of waste plastic into usable fuel.

5.Offers renewable energy source.

5.LIMITATIONS

It is difficult to collect produced hydrogen gas in this process. The production of fuel is limited to very small scale. It is still under process how to scale up the production level. It is still under research to apply this process to variety of plastics and not limited to certain polymeric plastic.

6.FUTURE SCOPE

The hydrogen extracted from process can be used in cars as well as for domestic purpose. This can be alternative to petrol as it's sources are limited and are decreasing day by day.

7.CONCLUSION

The amount of plastic produced is very high every year as well as most of which is not processed to waste. This plastic waste can be used to produce fuel as an alternative for the non-renewable sources of energy. This process involves cost effective methods as well as apparatus to produce fuel.

REFERENCES

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