

What perovskite was
found to be able



**ASSIGN
BUSTER**

What kind of Chemist am I? Perovskite is a calciumtitanium oxide (CaTiO_3) mineral and the compounds which have the same type of crystal structure as CaTiO_3 ($\text{A}^{2+}\text{B}^{4+}\text{O}_2$), known as perovskite. Perovskite was found to be able to absorb sunlight and generate electricity which made the researchers effectively use perovskite in solar cells, for color displays and for catalytic converters. Cerium incorporated perovskite: -1 Yue's group studied the effects of cerium incorporation on the catalytic oxidation of benzene over $\text{La}_{1-x}\text{Ce}_x\text{MnO}_3$ catalysts.

It was found out that the incorporation of cerium improves the benzene oxidation activity and the perovskite in which x was 0.1 exhibited highest activity. Incorporating cerium and manganese was essential as the oxygen storage capacity (OSC) is a characteristic property of $\text{Ce}^{3+}/\text{Ce}^{4+}$ ions and the synergistic effect between $\text{Ce}^{3+}/\text{Ce}^{4+}$ and $\text{Mn}^{3+}/\text{Mn}^{4+}$ has been known to enhance catalytic activity. The incorporation of cerium had a negligible effect on the specific surface area of the perovskite and hence this factor has little impact on the catalytic activity of perovskite.

The substitution of La^{3+} by Ce^{4+} resulted in an increase in the surface $\text{Mn}^{4+}/\text{Mn}^{3+}$ ratio and a decrease in the surface $\text{O}_{\text{ads}}/\text{O}_{\text{latt}}$ ratio due to charge neutralization. These trends in the $\text{Mn}^{4+}/\text{Mn}^{3+}$ and $\text{O}_{\text{ads}}/\text{O}_{\text{latt}}$ ratios exhibit good correlation with the catalytic activity during benzene oxidation, indicating that the Ce^{4+} induced modification of the $\text{Mn}^{4+}/\text{Mn}^{3+}$ ratio and the oxygen species was accompanied by enhanced catalytic activity. Yang's group investigated photocatalytic decomposition of water to produce hydrogen under UV radiation over layered perovskite

$\text{KBi}_3\text{PbTi}_5\text{O}_{16}$ photocatalyst synthesized by polymerized complex (PC)

method. The perovskite $\text{KBi}_3\text{PbTi}_5\text{O}_{16}$ was synthesized by the PC method at a lower calcination temperature (1073K, 2hrs) rather than the conventional solid state (SS) reaction method which include higher calcination temperature for a longer time (1273K, 6hrs). The photocatalyst was characterized by X-ray diffraction, ultraviolet-visible spectra, Brunauer-Emmett-Teller specific surface area, and FT-IR.

The perovskite $\text{KBi}_3\text{PbTi}_5\text{O}_{16}$ synthesized by PC method showed unique photocatalytic properties in the aqueous solution containing cerium species. The drawbacks of the sample prepared by the SS method which were a severe loss of alkaline-metal components and large grain growth (surface area shrinkage by heat treatment at high temperature), which may lead to low photocatalytic activities can be overcome by the preparation of perovskite using the PC method. It was found that the rate of hydrogen evolution was greatly improved and affected over the perovskite by the addition of $\text{Ce}(\text{SO}_4)_2$ in an aqueous suspension, which showed a volcano plot as a function of the concentration of $\text{Ce}(\text{SO}_4)_2$ passing through the maximum hydrogen evolution at $\text{Ce}(\text{SO}_4)_2 = 2.4 \text{ mM}$. This suggested that perovskite essential promoters for hydrogen production in the cerium-containing aqueous solution were the cerium(IV) cations adsorbed on the perovskite surface as well as Ce^{3+} in the aqueous phase, which were transformed from the Ce^{4+} species in the aqueous solution of cerium(IV) sulfate during the induction period. Those cerium cation promoters seem to be effectively recombining with the inhibitors of the photoexcited electron and hole resulting in more efficient way of hydrogen evolution by

photocatalytic decomposition of water. Song's group synthesized cerium and ytterbium codoped halide perovskite CsPbCl_{1-x}Br_x.

5 quantum dots (QDs) to try to improve the photoelectric conversion efficiency (PCE) of silicon solar cells (SSCs). They tried to overcome the limitation of PCE for SSCs which can be attributed to the low spectral response at ultraviolet (UV) and blue wavelengths (300–450 nm). So the incident photons of higher energy within UV-blue wavelengths are absorbed within a short distance from the surface, which results in high recombination loss. Considering the downconversion or quantum cutting of rare earth (RE) ions approach, they tried to improve the PCE whereby virtue of energy transfer processes between different RE centers, such as Ce³⁺ and Yb³⁺, quantum cutting can realize the emission of two or multiple near-infrared photons for each ultraviolet/visible photon absorbed and has potential to largely improve the PCE of SSCs as well as the other types of solar cells. So it is expected that the introduction of some rare earth (RE) ions with near-infrared emissions into lattices of the halide perovskite can exhibit the excellent optical properties of both RE ions (long lifetime and large Stokes shift) and the perovskite QDs (large absorption cross-section, weak electron-phonon coupling and high luminescence quantum yield) expand their optical properties. They synthesized various Yb³⁺-doped, Yb³⁺, Er³⁺, and Yb³⁺, Ce³⁺ codoped CsPbCl_xBr_{3-x} QDs, and their films were successfully self-assembled by liquid-phase depositing method in front of SSCs resulting in an extraordinary enhancement of PCE from 1.5% to 21.5%.

The larger absorption cross-section, weaker electron-phonon coupling and higher inner luminescent quantum yield contributed to

<https://assignbuster.com/what-perovskite-was-found-to-be-able/>

successfully explore the doped perovskite nanocrystals as a downconverter of commercial SSCs. Christou and coworkers synthesize 3-D perovskite $\text{Ce}_3\text{Mn}_8\text{O}_8(\text{O}_2\text{CPh})_{18}(\text{HO}_2\text{CPh})_2(\text{Ce}^{\text{III}})_2(\text{Ce}^{\text{IV}}\text{Mn}^{\text{III}})_8$ at high temperature in the solid state. The structure was determined by single-crystal X-ray diffraction and consists of a $\{\text{Ce}^{\text{IV}}\text{Mn}^{\text{III}}_8(\text{O})_8\}_{12}$ unit comprising a Mn_8 distorted cube with a Ce^{IV} at its center held together by four O^{2-} and four O^{4-} ions, with the latter connecting to two external Ce^{III} ions attached on opposite faces of the cube. The organic ligation consists of two O^{4-} , four O^{3-} , and twelve O^{2-} benzoate groups, as well as two terminal benzoic acid groups on the Ce^{III} ions.

All Mn^{III} atoms are six-coordinate with distorted octahedral geometries and exhibit Jahn-Teller (JT) distortion axes. The Ce^{III} and Ce^{IV} ions are nine-coordinate and eight-coordinate, respectively. The magnetic studies showed that Ce_3Mn_8 exhibits both in pair Mn^{III}_2 ferromagnetic and antiferromagnetic exchange interactions and the resultant spin vector alignments were within the 3-DC-type antiferromagnetic perovskite. Also from first-principles theoretical calculations, it was revealed that the expected nearest-neighbor Mn^{III}_2 exchange couplings via superexchange pathways through bridging ligands and an unusual, direct $\text{Mn}^{\text{III}}\text{-Ce}^{\text{IV}}\text{-Mn}^{\text{III}}$ metal-to-metal channel involving the Ce^{IV} f orbitals. I would like to carry out research mainly on the synthesis of perovskites involving cerium atom and find their application in various fields. The various oxidation state of cerium helps to use cerium as a catalyst.

Also they exhibit colossal magnetoresistance and multiferroicity, therefore these materials have potential applications in many technological fields such

<https://assignbuster.com/what-perovskite-was-found-to-be-able/>

as spintronics and information storage. , References: 1. GangLiu, Jiaqi Li, Kun Yang, Wenxiang Tang, Haidi Liu, Jun Yang, Renliang Yue??, Yunf Chen? Particuology 2015, 19, 60-682. Chong-Heng He†, O-Bong Yang* Ind.

Eng. Chem. Res. 2003, 42, 419-4253. Donglei Zhou, Dali Liu, Gencai Pan, XuChen, Dongyu Li, Wen Xu,* Xue Bai, Hongwei Song* Adv. Mater.

2017, 29, 17041494. Annaliese E. Thuijs1, Xiang-GuoLi2, Yun-Peng Wang2, Khalil A. Abboud1, X.-G. Zhang2, Hai-Ping Cheng2, George Christou1 Nat. Commun.

2017, 8, 500