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香港城市大學
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A Metallic Glass (MG) Catalyst for Wastewater Treatment

Energy & Environment

Nanotechnology and New Materials

Waste Treatment/Management

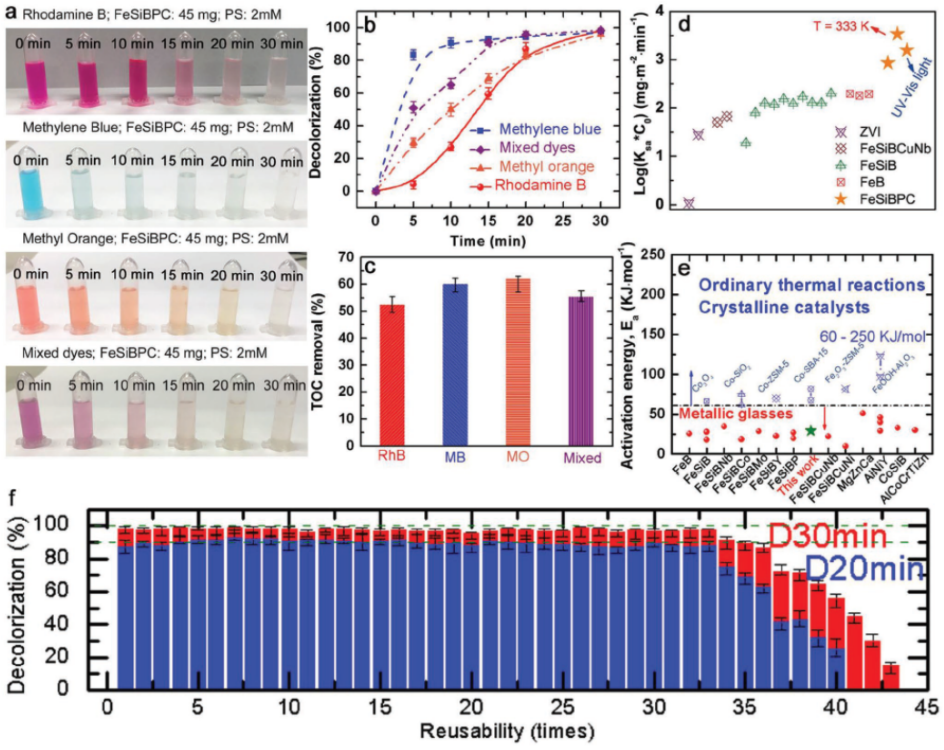

Figure 1. Catalytic performance. a) Visible color change; b) decolorization efficiency; c) TOC removal in various dye solutions using $Fe_{83}Si_2B_{11}P_3C_1$ amorphous catalysts; d) comparable results of dye degradation ability of $Fe_{83}Si_2B_{11}P_3C_1$ glassy ribbon and other Fe-based catalysts; e) comparison of activation energy (E_a) between amorphous and crystalline catalysts; f) reusability of the $Fe_{83}Si_2B_{11}P_3C_1$ glassy ribbon catalysts. (K_{sa} in (d) is the essential dye degradation ability calculated from the kinetic rate (k_{obs}) by dividing the area dosage ρ, which is calculated by $\rho = SV^{-1}$, where S and V denote the specific surface area of the catalysts and the volume of the dye solution, respectively. Additional details of (d) and (e) are presented in Tables S1 and S4 in the Supporting Information).

Opportunity

Global industrial wastewater treatment market is expected to rise to an estimated value of USD 17.22 billion by 2026, registering a substantial CAGR in the forecast period of 2019-2026. This rise in market value can be attributed to the growing urbanization & industrialization, and the growing regulatory requirements globally. Moreover, freshwater scarcity is one of the most critical challenges faced by industries, and is posing a major threat to the environment, water security, and economic growth. To meet the demand for freshwater, industries are increasingly employing recovery and wastewater recycling.

Metallic glass (MG), with the superiorities of unique disordered atomic structure and intrinsic chemical heterogeneity, is a new promising and competitive member in the family of environmental catalysts. Its implementation is facile, low-cost of fabrication, highly efficient, reusable and durable for industrial wastewater treatment.

IP Status
Patent granted

Technology Readiness Level (TRL) ? 4

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Technology

The present technology relates to a non-noble and multicomponent Fe83Si2B11P3C1 MG catalyst. Owing to the unique atomic coordination, the iron-based MG catalyst renders an electronic delocalization with an enhanced electron transfer. More importantly, the in situ self-reconstructed hierarchical gradient structure, which comprises a top porous sponge layer and a thin amorphous oxide interfacial layer encapsulating the MG surface, provides matrix protection together with high permeability and more active sites. It consequently presents a fascinating catalytic efficiency with remarkable stability for industrial wastewater treatment.

Advantages

- The invented iron-based MG catalyst performs the activation of persulfate/peroxymonsulfate to generate sulfate and hydroxyl radicals degrading organic wastewater pollutants efficiently.
- It is mainly in glassy ribbon state with an amorphous/nano-crystalline structure which is flexible to be fabricated by company of manufacturing metal materials. Moreover, the fabrication process is facile and simple.
- There is no any restrictively operational condition, such as temperature, UV-radiation, electric field and pH value, in the wastewater treatment.
- It has the advantages of relatively high efficiency, long reusability and low-cost for wastewater treatment compared to the existing catalyst.

Applications

- The invented Fenton-like reaction MG catalyst is able to implement into metallic glass system or apparatus of wastewater treatment that degrades the pollutants from the industry of textile, printing, pharmaceutical and residence where usually generates amount of organic waste.