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Photocatalysis: Preface

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A recent search of the keyword "Photocatalysis" in the CAS SciFinder® database shows that at least 5,000 articles on this topic have been published each year from 2014 to 2016. It is expected that even more articles on this topic will be published in the foreseeable future. These data indicate the importance of "Photocatalysis" in the field. The first application of photocatalysis was on energy production. Since then, the photocatalytic energy production, such as water splitting for the production of hydrogen and oxygen and conversion of carbon dioxide to methanol or methane, has been one of the major focal areas. However, with numerous studies reported since 1980, it is widely accepted that photocatalysis is a promising reduction-oxidation technology for environmental applications. The photogenerated electrons (e^-) and holes (h^+), and the reactive oxygen species (ROS) derived from these charged species can effectively transform (degrade and perhaps detoxify) environmental toxicants, such as metal-containing compounds, other inorganics and organics, by either reduction (photogenerated e^-) or oxidation (photogenerated h^+ and ROS).

There are numerous articles on the photocatalytic applications, such as wastewater treatment (Xiao et al., 2016; Wu et al., 2016), disinfection of bacteria (Huber et al., 2016; Wang et al., 2015), antibiotics degradation (Chen et al., 2016; Mohammadzadeh et al., 2015), and elimination of indoor volatile organic compounds (Chen et al., 2015a, 2015b), published in *Journal of Environmental Sciences*. Recognizing photocatalysis as an active area of environmental research, we have organized this special issue, with 14 articles focusing on various important aspects of photocatalysis. Several articles reported on the modifications of the most commonly used photocatalysts, titanium dioxide (TiO_2), by changing the physico-chemical structure of the nanoparticle (Wang et al., 2017), doping with nitrogen (N) and carbon (C) (Li et al., 2017a), coating TiO_2 on MgAl hydrotalcite, a layered double oxide (Xiao et al., 2017), doping TiO_2 on Ag@AgCl and coating on sepiolite, a soft white clay (Liu et al., 2017), coating TiO_2 onto PANI (polyaniline, a semi-flexible conducting polymer) supported by cork (Sboui et al., 2017),and doping of zirconium (Zr) to TiO_2 (Huang et al., 2017) to enhance the photocatalytic activity of TiO_2 for degrading various types of target compounds. These modifications to the TiO_2-based photocatalysts result in broadening the photocatalysts' absorption of visible light spectrum, increasing their surface area for better adsorption of target compounds, or reducing the recombination of photogenerated e^--h^+ in order to enhance photocatalytic activity of the modified TiO_2.

The difficulty of recovering nano-sized photocatalysts after treatment usually hinders the application of photocatalysis. Li et al. (2017b) developed a magnetic organic photocatalyst for degradation of organics. The spent photocatalyst can be easily recovered by applying an external magnetic field. The design of photocatalytic reactor greatly affects the treatment efficiency of the process. Özkal et al. (2017) reports a parallel plate reactor with thin-films coated photocatalyst with remarkable performance in degradation of antibiotics (Levofloxacin and Cefaclor).

In order to effectively utilize the visible light spectrum of sunlight, other non-TiO_2 photocatalysts, such as bismuth oxide (BiOBr) doped with $BiVO_4$, showed very good visible-light-driven (VLD) photocatalytic activity in degradation of organics (Yin et al., 2017). Xue et al. (2017) also reported that La/Ce co-doped Bi_2O_3 composite showed very good VLD photocatalytic activity. Wen et al. (2017) used Cedes for VLD photocatalytic degradation of an antibiotic, tetracycline hydrochloride. While Chan et al. (2017) even used the earth abundant element, red phosphorus, as a VLD photocatalyst for organic degradation.

With the assistance of applied low bias and natural photosystem II, great improvement of conversion of CO_2 to methanol and oxygen (O_2) evolution was obtained by photoelectrocatalytic (PEC) system (Lian et al., 2017). Thabit et al. (2017) also demonstrated that co-doping of Pd-MnO_2 on TiO_2 nanotube array (NTA) performed very well in degradation of organics by PEC.

The results of these articles truly reflect the variety of the applications of photocatalysis. With the rapid development in photocatalysis, we expect more effective and efficient energy production and photocatalytic degradation of

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environmental contaminants in the near future. This special issue of Journal of Environmental Sciences on “Photocatalysis” is an effort to showcase recent advances and to stimulate further interest.

REFERENCES

Chan, D.K.L., Yu, J.C., Li, Y.C., Hu, Z.H., 2017. A metal-free composite photocatalyst of graphene quantum dots deposited on red phosphorus. J. Environ. Sci. 60, 91–97.

Chen, K.Y., Zhu, L.Z., Yang, K., 2015a. Tricrystalline TiO_2 with enhanced photocatalytic activity and durability for removing volatile organic compounds from indoor air. J. Environ. Sci. 32, 189–195.

Chen, K.Y., Zhu, L.Z., Yang, K., 2015b. Acid-assisted hydrothermal synthesis of nanocrystalline TiO_2 from titanate nanotubes: Influence of acids on the photodegradation of gaseous toluene. J. Environ. Sci. 27, 232–240.

Chen, H.L., Peng, Y.P., Chen, K.F., Lai, C.H., Lin, Y.C., 2016. Rapid synthesis of Ti-MCM-41 by microwave-assisted hydrothermal method towards photocatalytic degradation of oxytetracycline. J. Environ. Sci. 44, 76–87.

Huang, C., Ding, Y.P., Chen, Y.W., Li, P.W., Zhu, S.M., Shen, S.B., 2017. Highly efficient Zr doped-TiO_2/glass fiber photocatalyst and its performance in formaldehyde removal under visible light. J. Environ. Sci. 60, 61–69.

Huber, J.M., Carlson, K.L., Conroy-Ben, O., Misra, M., Mohanty, S.K., 2016. Development of a field enhanced photocatalytic device for biocide of coliform bacteria. J. Environ. Sci. 44, 38–44.

Li, H., Cao, L., Yang, C.J., Zhang, Z.H., Zhang, B.G., Deng, K.J., 2017a. Selective oxidation of benzyl alcohols to benzoic acid catalyzed by eco-friendly cobalt thioporphyrazine catalyst supported on silica-coated magnetic nanospheres. J. Environ. Sci. 60, 84–90.

Li, F.Z., Zhou, J.S., Du, C., Li, W., Wang, Y.Z., He, G.N., et al., 2017b. Preparation and photocatalytic properties of porous C and N co-doped TiO_2 deposited on brick by a fast, one-step microwave irradiation method. J. Environ. Sci. 60, 24–32.

Lian, Z.C., Pan, D.L., Wang, W.C., Zhang, D.Q., Li, G.S., Li, H.X., 2017. Photoelectrocatalytic reduction of CO_2 to methanol over photosystem II-enhanced Cu foam/Si-nanowire system. J. Environ. Sci. 60, 108–113.

Liu, S.M., Zhu, D.L., Zhu, J.L., Yang, Q., Wu, H.J., 2017. Preparation of Ag@AgCl-doped TiO_2/sepiolite and its photocatalytic mechanism under visible light. J. Environ. Sci. 60, 43–52.

Mohammadzadeh, S., Olya, M.E., Arabi, A.M., Shariati, A., Nikou Khosravi, M.R., 2015. Synthesis, characterization and application of ZnO-Ag as a nanophotocatalyst for organic compounds degradation, mechanism and economic study. J. Environ. Sci. 35, 194–207.

Özkal, C.B., Frontistis, Z., Antonopoulou, M., Konstantinou, I., Mantzavinos, D., Meriç, S., 2017. Removal of antibiotics in a parallel-plate thin-film-photocatalytic reactor: Process modelling and evolution of transformation by-products and toxicity. J. Environ. Sci. 60, 114–122.

Sboui, M., Nsib, M.F., Rayes, A., Swaminathan, M., Houas, A., 2017. TiO_2–PANI/Cork composite: A new floating photocatalyst for the treatment of organic pollutants under sunlight irradiation. J. Environ. Sci. 60, 3–13.

Thabit, M., Liu, H.L., Zhang, J., Wang, B., 2017. Pd-MnO_2 nanoparticles/TiO_2 nanotube arrays (NTAs) photo-electrodes photocatalytic properties and their ability of degrading Rhodamine B under visible light. J. Environ. Sci. 60, 53–60.

Wang, W.J., Huang, G.C., Yu, J.C., Wong, P.K., 2015. Advances in photocatalytic disinfection of bacteria: Development of photocatalysts and mechanisms. J. Environ. Sci. 34, 232–247.

Wang, H., Shi, G.D., Zhang, X.S., Zhang, W., Huang, L., Yu, Y., 2017. *In-situ* synthesis of TiO_2 rutile/anatase heterostructure by DC magnetron sputtering at room temperature and thickness effect of outermost rutile layer on photocatalysis. J. Environ. Sci. 60, 33–42.

Wen, J.S., Ma, C.C., Huo, P.W., Liu, X.L., Wei, M.B., Liu, Y., et al., 2017. Construction of vesicle CdSe nano-semiconductors photocatalysts with improved photocatalytic activity: enhanced photo induced carriers separation efficiency and mechanism insight. J. Environ. Sci. 60, 98–107.

Wu, Q.Y., Li, Y., Wang, W.L., Wang, T., Hu, H.Y., 2016. Removal of C.I. Reactive Red 2 by low pressure UV/chlorine advanced oxidation. J. Environ. Sci. 41, 227–234.

Xiao, S.H., Wan, D.J., Zhang, K., Qu, H.B., Peng, J.F., 2016. Enhanced photoelectrocatalytic degradation of ammonia by *in situ* photoelectrogenerated active chlorine on TiO_2 nanotube electrodes. J. Environ. Sci. 50, 103–108.

Xiao, G.F., Zeng, H.Y., Xu, S., Chen, C.R., Zhao, Q., Liu, X.J., 2017. Preparation of Ti species coating hydrotalcite by chemical vapor deposition for photodegradation of azo dye. J. Environ. Sci. 60, 14–23.

Xue, S.S., He, H.B., Fan, Q.Z., Yu, C.L., Yang, K., Huang, W.Y., et al., 2017. La/Ce-codoped Bi_2O_3 composite photocatalysts with high photocatalytic performance in removal of high concentration dye. J. Environ. Sci. 60, 70–77.

Yin, W.Z., Sun, X., Wang, W.Z., 2017. Enhancement of photocatalytic efficiency by in situ fabrication of BiOBr/BiVO4 surface junctions. J. Environ. Sci. 60, 78–83.