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1. Main Research Results

1) Novel Nitrogen-Doped Lamellar Niobic Acid with Visible Light-Responsive Photocatalytic Activity

We have succeeded for the first time in the development of a simple lamellar-solid acid photocatalyst with good visible light-responsive photocatalytic activity. By a facile solid reaction-urea method, nitrogen could be successfully doped into HNb_3O_8 without destroying the layered structure. Because of the favorable properties like the layered structure, the light absorption characteristic, and the protonic acidity, the nitrogen-doped HNb_3O_8 photocatalyst showed superior activity than Degussa P25 and the nitrogen-doped Nb_2O_5 and TiO_2 samples under visible light irradiation. This study disclosed some novel chemistry related to nitrogen doping and the resultant visible light photocatalysis, and is expected to be able to provide a generic strategy for the preparation of solid acid photocatalysts with high visible light-responsive activities.

References

- 1) X. Li, N. Kikugawa, J. Ye, *Adv. Mater.*, **20**, pp.3816-3819, 2008.
- 2) X. Li, N. Kikugawa, J. Ye, *Chemistry – A European Journal*, in press

2. List of publication (original article, comment/book)

1) Original Paper

- (1) Defa Wang, Tetsuya Kako, Jinhua Ye, "A Novel Series of Solid-solution Semiconductors $(\text{AgNbO}_3)_{1-x}(\text{SrTiO}_3)_x$ with Modulated Band Structure and Enhanced Visible-light Photocatalytic Activity", *J. Phys. Chem.C*, in press.
- (2) M. V. Shankar, T. Kako, J. Ye, "One-pot synthesis of peroxo-titania nanopowder and dual photochemical oxidation in aqueous methanol solution", *J. Colloid and Interface Science*, 331, pp.132-139, 2009.
- (3) S. Ouyang, N. Kikugawa, D. Chen, J. Ye, Z. Zou, "A Systematical Study on Photocatalytic Properties of AgMO_2 (M=Al, Ga, In): Effects of Chemical Compositions, Crystal Structures, and Electronic Structures", *J. Phys. Chem.C*, in press.
- (4) G. Li, T. Kako, D. Wang, Z. Zou and J. Ye, "Enhanced Photocatalytic Activity of La-doped AgNbO_3 under Visible Light Irradiation", *Dalton transactions*, in press.
- (5) Xiukai Li, Naoki Kikugawa, Jinhua Ye, "A Comparison Study on Rhodamine B Photodegradation over Nitrogen-Doped Lamellar Niobic Acid and Titanic Acid under Visible Light Irradiation", *Chemistry-A European Journal*, in press.
- (6) G. Li, D. Wang, Z. Zou and J. Ye, "Enhancement of Visible-light Photocatalytic Activity of $\text{Ag}_{0.7}\text{Na}_{0.3}\text{NbO}_3$ Modified by a Platinum Complex", *J. Phys. Chem.C*, 112, pp.20329-20333, 2008.

- (7) Xiukai Li, Naoki Kikugawa, Jinhua Ye, "Novel Nitrogen-Doped Lamellar Niobic Acid with Visible Light-Responsive Photocatalytic Activity", *Advanced Materials*, 20, pp.3816-3819, 2008.
- (8) Guoqiang Li, Tetsuya Kako, Defa Wang, Zhigang Zou and Jinhua Ye, "Synthesis and enhanced photocatalytic activity of NaNbO_3 prepared by hydrothermal and polymerized complex methods", *J. Phys. Chem. Solids*, 69, pp.2487-2491, 2008
- (9) Wenjun Luo, Zhaosheng Li, Xiaojun Jiang, Tao Yu, Lifei Liu, Xinyi Chen, Jinhua Ye, Zhigang Zou, "Correlation between the band positions of $(\text{SrTiO}_3)_{(1-x)}\text{center dot}(\text{LaTiO}_2\text{N})_{(x)}$ solid solutions and photocatalytic properties under visible light irradiation", *Phys. Chem. Chem. Phys.*, 10, pp.6717-6723, 2008.
- (10) Di Chen, Jinhua Ye, "Hierarchical WO_3 Hollow Shells: Dendrite, Sphere and Dumbbell and Their Photocatalytic Properties", *Advanced Functional Materials*, 18, pp.1922-1928, 2008.
- (11) Xiaoxing Fan, Xinyi Chen, Shaopeng Zhu, Zhaosheng Li, Tao Yu, Jinhua Ye and Zhigang Zou, "The Structural, Physical and Photocatalytic Properties of the Mesoporous Cr-doping TiO_2 ", *Journal of Molecular Catalysis A: Chemical*, 284, pp.155-160, 2008.
- (12) Xiaoxing Fan, Tao Yu, Ying Wang, Jing Zheng, Ling Gao, Zhaosheng Li, Jinhua Ye and Zhigang Zou, "Role of Phosphorus in Synthesis of Phosphated Mesoporous TiO_2 Photocatalytic Materials by EISA Method", *Applied Surface Science*, 254, pp.5191-5198, 2008.
- (13) Yupeng Yuan, Jing Zheng, Xueliang Zhang, Zhaosheng Li, Tao Yu, Jinhua Ye and Zhigang Zou, "BaCeO₃ as a novel photocatalyst with 4f electronic configuration for water splitting", *Solid State Ionics.*, 178, pp.1711-1713, 2008.
- (14) Defa Wang, Tetsuya Kako, Jinhua Ye, "Efficient decomposition of acetaldehyde over a perovskite-type solid solution photocatalyst $(\text{Ag}_{0.75}\text{Sr}_{0.25})(\text{Nb}_{0.75}\text{Ti}_{0.25})\text{O}_3$ under visible light irradiation", *J. Am. Chem. Soc.*, 130, pp. 2724-2725, 2008.
- (15) Shuxin Ouyang, Zhaosheng Li, Zi Ouyang, Tao Yu, Jinhua YE, and Zhigang Zou, "Correlation of Crystal Structures, Electronic Structures, and Photocatalytic Properties in a series of Ag-based Oxides: AgAlO_2 , AgCrO_2 , Ag_2CrO_4 ", *J. Phys. Chem. C*, 112, pp. 3134-3141, 2008.
- (16) Jiahui Kou, Haitao Zhang, Zhaosheng Li, Shuxin Ouyang, Jinhua Ye, Zhigang Zou, "Photooxidation of Polycyclic Aromatic Hydrocarbons over NaBiO_3 under Visible Light Irradiation", *Catal Lett.*, 122, pp. 131-137, 2008
- (17) Wenjun Luo, Junwang Tang, Zhigang Zou, Jinhua Ye, "Preparation and photophysical properties of some oxides in Ca-Bi-O System", *Journal of Alloys and Compounds*, 445, pp.346-352, 2008.
- (18) Weifeng Yao, Hideo Iwai, Jinhua Ye, "Effects of molybdenum substitution on the photocatalytic behavior of BiVO_4 ", *Dalton Trans.*, pp.1426-1430, 2008.
- (19) M. Oshikiri, M. Boero, A. Matsushita, J. Ye, "Dissociation of water molecule at three-fold oxygen coordinated V sites on the InVO_4 (001) surface", *Appl. Surf. Sci.*, vol. 255 p. 679-681 (2008)
- (20) Xiukai Li, Shuxin Ouyang, Naoki Kikugawa, Jinhua Ye, "Novel $\text{Ag}_2\text{ZnGeO}_4$ Photocatalyst for Dye Degradation under Visible Light Irradiation", *Applied Catalysis A: General*, 334, pp.51-58, 2008.
- (21) Weifeng Yao, Jinhua Ye, "A new efficient visible-light-driven photocatalyst $\text{Na}_{0.5}\text{Bi}_{1.5}\text{VMoO}_8$ for

oxygen evolution”, *Chem. Phys. Lett.*, 450, pp.370-374, 2008.

(22)Tetsuya Kako, Naoki Kikugawa, Jinhua Ye, “Photocatalytic activity of AgSbO₃ under visible light irradiation”, *Catalysis Today*, 131, pp.197-202, 2008.

3. Invited/Plenary Talks in Conference

1) International Conference or Workshop

- (1) Jinhua YE, Tetsuya KAKO, Defa WANG, CHEN Di, Xiukai LI, Synthesis and Characterization of New Nano-structured Photocatalytic Materials Active Under Visible Light Irradiation, Joint Conferences of The 2nd International Conference on the Science and Technology for Advanced Ceramics (STAC–STSI), 2008/05/30 -06/01, OVTA (Chiba) (Invited talks)
- (2) Jinhua YE, Tetsuya KAKO, Guoqiang LI, Defa WANG, Zhigang ZOU, New Nb-containing oxide photocatalysts for efficient degradation of organics under weak visible light irradiation, 17th International Conference on Photochemical Conversion and Storage of solar energy, 2008/07/27 - 08/01, Sydney convention and exhibition Centre, Sydney (Invited talks)
- (3) Jinhua YE, Research and Development of Visible Light Sensitive Photocatalysts, 4th Hokkaido University & Nanjing University Joint Symposium, 2008/12/17, Hokkaido University (Invited talks)
- (4) Jinhua YE, Tetsuya KAKO, Defa WANG, Di CHEN, Xiukai LI, Zhigang ZOU, New Visible-light-sensitive Photocatalytic Materials for Environmental Purification, The 9th International Symposium on Ceramic Materials and Component, Shanghai Institute of Ceramics, 2008/11/10-14, Shanghai International Convention Center, Shanghai (Invited talks)
- (5) Jinhua YE, Nano photocatalysis: An ultimate green technology for a sustainable society, NIMS-New Zealand Workshop on Nanomaterials , 2009/01/28-29, NIMS, Tsukuba (Invited talks)
- (6) Jinhua YE, Tetsuya KAKO, Defa WANG, Xiukai LI, Di CHEN, Synthesis and Characterization of Novel Nano-structured Oxide Photocatalytic Materials Active under Visible-light-irradiation, Photo Functionalized Materials Society , Asian Academic Seminar 2009, 2009/03/02-06, KSP Hall, Kawasaki (Invited talks)
- (7) Jinhua YE, Research Activities of NIMS Photocatalytic Materials Center, 2009/03/05-07, 2ndChina-Japan Symposium on Advanced Photocatalytic Materials, Nanjing University, Nanjing, China (Invited talks)
- (8) Jinhua YE, Nano photocatalysis: An ultimate green technology for a sustainable society, The 2nd International Symposium on Interdisciplinary Materials Science 2009, 2009/03/09-10, Epcoc Tsukuba, Tsukuba (Invited talks)
- (9) Hua TONG, Jinhua YE, Synthesis and Photocatalytic Properties of Niobate Nanomaterials, The 9th International Symposium on Ceramic Materials and Component, Shanghai Institute of Ceramics, 2008/11/10 -14, Shanghai International Convention Center, Shanghai (Oral Presentation)

- (10) Tetsuya KAKO, Jinhua YE, Photocatalytic and photophysical properties of silver antimonite, 2ndChina-Japan Symposium on Advanced Photocatalytic Materials, 2009/03/05 – 07, Nanjing University, Nanjing (Oral Presentation)
- (11) Naoki KIKUGAWA, Jinhua YE, Dye-degradation property of a semiconductor LiBiO₃ under the irradiation of white fluorescent lamp, 2ndChina-Japan Symposium on Advanced Photocatalytic Materials, 2009/03/05-07, Nanjing University, Nanjing (Oral Presentation)
- (12) Li Xiukai, Naoki KIKUGAWA, Jinhua YE, Facile Preparation of Nitrogen-Doped Lamellar Solid Acids with Visible Light-Responsive Photocatalytic Activities, 2ndChina-Japan Symposium on Advanced Photocatalytic Materials, 2009/03/05-07, Nanjing University, Nanjing (Oral Presentation)
- (13) Di CHEN, Jinhua YE, WO₃ Nanostructures: Synthesis, Characterization and Enhanced Photocatalytic Activities, 2ndChina-Japan Symposium on Advanced Photocatalytic Materials, 2009/03/05-07, Nanjing University, Nanjing (Oral Presentation)
- (14) Hua TONG, Jinhua YE, A General Synthesis Route for Nano Niobate Photocatalysts, 2ndChina-Japan Symposium on Advanced Photocatalytic Materials, 2009/03/05-07, Nanjing University, Nanjing (Oral Presentation)
- (15) Qiuye LI, Jinhua YE, Visible light induced photocatalytic activity on one-dimensional nanostructured silver titanate, 2ndChina-Japan Symposium on Advanced Photocatalytic Materials, 2009/03/05-07, Nanjing University, Nanjing (Oral Presentation)
- (16) CHEN Di, Jinhua YE, Synthesis of Nanostructured SrSnO₃ Photocatalysts and their Photocatalytic Properties, Joint Conferences of The 2nd International Conference on the Science and Technology for Advanced Ceramics (STAC—STSI), 2008/05/30- 06/01, OVTA, Chiba (Poster Presentation)
- (17) Defa WANG, Tetsuya KAKO, Efficient degradation of organic pollutants over a new series of solid solution photocatalysts (AgNbO₃)_{1-x}(SrTiO₃)_x under visible-light irradiation, Joint Conferences of The 2nd International Conference on the Science and Technology for Advanced Ceramics (STAC — STSI), 2008/05/30-06/01, OVTA, Chiba (Poster Presentation)
- (18) Xiukai LI, Naoki KIKUGAWA, Jinhua YE, Dye Degradation over Nitrogen-Doped Lamellar Niobic Acid under Visible Light Irradiation, Joint Conferences of The 2nd International Conference on the Science and Technology for Advanced Ceramics (STAC — STSI), 2008/05/30-06/01, OVTA, Chiba (Poster Presentation)
- (19) Di CHEN, Jinhua YE, Synthesis of nanostructured photocatalysts and their enhanced photoactivities, 17th International Conference on Photochemical Conversion and Storage of solar energy, 2008/07/27 - 08/01, Sydney convention and exhibition Centre, Sydney (Poster Presentation)
- (20) Xiukai LI, Naoki KIKUGAWA, Jinhua YE, Preparation and Characterization of Nitrogen-Doped Lamellar Niobic Acid with Visible Light-Responsive Photocatalytic Activity, 17th International

Conference on Photochemical Conversion and Storage of solar energy, 2008/07/27 - 08/01, Sydney convention and exhibition Centre, Sydney (Poster Presentation)

2) Domestic Conferences

- (1) Jinhua YE, Research and Development of Highly Efficient Photocatalytic Materials—Introduction of NIMS Photocatalytic Materials Center, Hokkaido University G-COE & NIMS MANA Joint Symposium, 2008/05/27-28, Hokkaido University, Sapporo (Invited talks)
- (2) Jinhua YE, Tetsuya KAKO, Defa WANG, Research and Development of Novel Photocatalytic Materials, Photo Functionalized Materials Society, 2008/7/16, University of Tokyo, Tokyo (Invited talks)
- (3) Jinhua YE, Nano photocatalysis: An ultimate green technology for a sustainable society, ISEET-2008, 2008/08/27, Saitama Institute of Technology, Saitama (Invited talks)
- (4) Jinhua YE, Novel photocatalytic materials active under visible light irradiation, Photo Functionalized Materials Society, 2008/12/02, KSP Hall, Kawasaki (Invited talks)
- (5) Jinhua YE, Photocatalytic Materials—Subjects and Challenge, Goint Symposium of 4 Ceramic Research Institutions, 2009/01/27, NIMS, Tsukuba (Invited talks)
- (6) Jinhua YE, Tetsuya KAKO, Defa WANG, L I Xiukai, Di CHEN, Naoki KIKUGAWA, Research and Development of Novel Photocatalytic Materials, Japan Chemical Society Annual Meeting 2009, 2009/03/27-29, Nihon University, Funabashi, Chiba (Invited talks)
- (7) L I Xiukai, Naoki KIKUGAWA, Jinhua YE, Development of Nitrogen-doped Lamellar Solid Acids for Visible Light Photocatalysis, Photo Functionalized Materials Society, 2008/12/02, KSP Hall, Kawasaki (Poster Presentation)
- (8) Di CHEN, Jinhua YE, Niobates Nanostructures: Synthesis, Characterization and Photocatalytic Properties, Photo Functionalized Materials Society, 2008/12/02, KSP Hall, Kawasaki (Poster Presentation)
- (9) HuaTONG, Jinhua YE, Synthesis and Photocatalytic Properties of CdS Nanomaterials, Photo Functionalized Materials Society, 2008/12/02, KSP Hall, Kawasaki (Poster Presentation)
- (10) Qiuye LI, Tetsuya KAKO, Jinhua YE, Preparation of (Fe(III), Co(II), Ni(II)) titanate by microwave synthesis and evaluation of their photocatalytic activity under visible light, Photo Functionalized Materials Society, 2008/12/02, KSP Hall, Kawasaki (Poster Presentation)

4. Others

1) International Collaboration

- (1) Collaborate with Nanjing Univ., China, on “Research on solar energy conversion and environmental purification materials”. Exchanges of researchers (including graduate school students), exchanges of research information and promotion of joint research programs were actively conducted.
- (2) Collaborate with Universität Hannover, Germany, on “Research and Development of Photocatalysis Materials”. Exchanges of researchers (including graduate school students), exchanges of research

information and promotion of joint research programs were actively conducted.

- (3) Host Graduate student from Gwangju Institute of Science and Technology, Korea, basing on Japan-Korea Exchange Program, to conduct “Study of Photocatalysts for Hydrogen Evolution as Sustainable Bioenergy”

2) Others

Organize the 2nd Japan-China Joint Symposium on Advanced Photocatalytic Materials, March 5-7, 2009, Nanjing, China