

## References:

- [1] Logothetidis S. Nanostructured materials and their applications: Springer Science & Business Media; 2012.
- [2] Buzea C, Pacheco II, Robbie K. Nanomaterials and nanoparticles: sources and toxicity. *Biointerphases* 2007;2:MR17-MR71.
- [3] Fernández-García M, Rodríguez JA. Metal oxide nanoparticles. *Encyclopedia of inorganic and bioinorganic chemistry* 2011.
- [4] Nunes D, Pimentel A, Santos L, Barquinha P, Pereira L, Fortunato E, et al. 1 - Introduction. In: Nunes D, Pimentel A, Santos L, Barquinha P, Pereira L, Fortunato E, et al., editors. *Metal Oxide Nanostructures*: Elsevier; 2019. p. 1-19.
- [5] Feynman RP. There's plenty of room at the bottom [data storage]. *Journal of microelectromechanical systems* 1992;1:60-6.
- [6] Taniguchi N, ARAKAWA C, KOBAYASHI T. On the basic concept of 'nano-technology'. *Proceedings of the International Conference on Production Engineering, 1974-8; 1974*. p. 18-23.
- [7] Zhang Y, Zhou Q, Zhu J, Yan Q, Dou SX, Sun W. Nanostructured Metal Chalcogenides for Energy Storage and Electrocatalysis. *Advanced Functional Materials* 2017;27:1702317.
- [8] Kundu S, Patra A. Nanoscale strategies for light harvesting. *Chemical Reviews* 2016;117:712-57.
- [9] Xu L, Liang H-W, Yang Y, Yu S-H. Stability and reactivity: positive and negative aspects for nanoparticle processing. *Chemical reviews* 2018;118:3209-50.
- [10] Balzani V. Nanoscience and Nanotechnology: A Personal View of a Chemist. *Small* 2005;1:278-83.
- [11] Shehzad K, Xu Y, Gao C, Duan X. Three-dimensional macro-structures of two-dimensional nanomaterials. *Chemical Society Reviews* 2016;45:5541-88.
- [12] Edvinsson T. Optical quantum confinement and photocatalytic properties in two-, one- and zero-dimensional nanostructures. *Royal Society open science* 2018;5:180387.
- [13] Logothetidis S. *Nanotechnology: Principles and applications*. Nanostructured Materials and Their Applications: Springer; 2012. p. 1-22.
- [14] Virk HS. *Nanomaterials*: Trans Tech Publications Ltd; 2014.
- [15] Murray RW. *Nanoelectrochemistry: Metal Nanoparticles, Nanoelectrodes, and Nanopores*. *Chemical Reviews* 2008;108:2688-720.
- [16] Huo D, Kim MJ, Lyu Z, Shi Y, Wiley BJ, Xia Y. *One-Dimensional Metal Nanostructures: From Colloidal Syntheses to Applications*. *Chemical reviews* 2019;119:8972-9073.
- [17] Watanabe K, Menzel D, Nilius N, Freund H-J. *Photochemistry on Metal Nanoparticles*. *Chemical Reviews* 2006;106:4301-20.
- [18] Zheng Z, Huang B, Qin X, Zhang X, Dai Y, Whangbo M-H. Facile in situ synthesis of visible-light plasmonic photocatalysts M@ TiO<sub>2</sub> (M= Au, Pt, Ag) and evaluation of their photocatalytic oxidation of benzene to phenol. *Journal of Materials Chemistry* 2011;21:9079-87.
- [19] Ayesh A, Qamhieh N, Ghamlouche H, Thaker S, El-Shaer M. Fabrication of size-selected Pd nanoclusters using a magnetron plasma sputtering source. *Journal of Applied Physics* 2010;107:034317.
- [20] Wen Y-H, Huang R, Zeng X-M, Shao G-F, Sun S-G. Tetrahedral Pt-Pd alloy nanocatalysts with high-index facets: an atomistic perspective on thermodynamic and shape stabilities. *Journal of Materials Chemistry A* 2014;2:1375-82.
- [21] Lokhande CD. A chemical method for preparation of metal sulfide thin films. *Materials Chemistry and Physics* 1991;28:145-9.
- [22] Sui R, Charpentier P. Synthesis of metal oxide nanostructures by direct sol-gel chemistry in supercritical fluids. *Chemical reviews* 2012;112:3057-82.
- [23] Han C. *Synthesis of nanostructured metal chalcogenides used for energy conversion and storage*. 2015.
- [24] Paliwal A, Singh SV, Sharma A, Sugathan A, Liu S-W, Biring S, et al. Microwave-Polyol Synthesis of Sub-10-nm PbS Nanocrystals for Metal Oxide/Nanocrystal Heterojunction Photodetectors. *ACS Applied Nano Materials* 2018;1:6063-72.
- [25] Man GJS. *Metal Oxide/Semiconductor Heterojunctions as Carrier-Selective Contacts for Photovoltaic Applications*: Princeton University; 2017.

- [26] Zhang Y, He S, Guo W, Hu Y, Huang J, Mulcahy JR, et al. Surface-plasmon-driven hot electron photochemistry. *Chemical reviews* 2017;118:2927-54.
- [27] Helland Å. Nanoparticles: a closer look at the risks to human health and the environment perceptions and precautionary measures of industry and regulatory bodies in Europe. 2004.
- [28] Hoffmann MR, Martin ST, Choi W, Bahnemann DW. Environmental applications of semiconductor photocatalysis. *Chemical reviews* 1995;95:69-96.
- [29] Gilroy KD, Ruditskiy A, Peng H-C, Qin D, Xia Y. Bimetallic nanocrystals: syntheses, properties, and applications. *Chemical reviews* 2016;116:10414-72.
- [30] Varma A, Mukasyan AS, Rogachev AS, Manukyan KV. Solution combustion synthesis of nanoscale materials. *Chemical reviews* 2016;116:14493-586.
- [31] Ueno K, Oshikiri T, Sun Q, Shi X, Misawa H. Solid-state plasmonic solar cells. *Chemical reviews* 2017;118:2955-93.
- [32] Humayun M, Raziq F, Khan A, Luo W. Modification strategies of TiO<sub>2</sub> for potential applications in photocatalysis: a critical review. *Green Chemistry Letters and Reviews* 2018;11:86-102.
- [33] Nunes D, Pimentel A, Santos L, Barquinha P, Pereira L, Fortunato E, et al. *Metal Oxide Nanostructures: Synthesis, Properties and Applications*: Elsevier; 2018.
- [34] Chen Y, Fan Z, Zhang Z, Niu W, Li C, Yang N, et al. Two-dimensional metal nanomaterials: synthesis, properties, and applications. *Chemical reviews* 2018;118:6409-55.
- [35] Gao M-R, Xu Y-F, Jiang J, Yu S-H. Nanostructured metal chalcogenides: synthesis, modification, and applications in energy conversion and storage devices. *Chemical Society Reviews* 2013;42:2986-3017.
- [36] Pal G, Rai P, Pandey A. Chapter 1 - Green synthesis of nanoparticles: A greener approach for a cleaner future. In: Shukla AK, Iravani S, editors. *Green Synthesis, Characterization and Applications of Nanoparticles*: Elsevier; 2019. p. 1-26.
- [37] Talapin DV, Lee J-S, Kovalenko MV, Shevchenko EV. *Prospects of Colloidal Nanocrystals for Electronic and Optoelectronic Applications*. *Chemical Reviews* 2010;110:389-458.
- [38] Bréchnignac C, Houdy P, Lahmani M. *Nanomaterials and nanochemistry*: Springer Science & Business Media; 2008.
- [39] Toro R. *Optical Spectroscopy of Novel Quantum Dot Structures*: University of Sheffield; 2014.
- [40] Burda C, Chen X, Narayanan R, El-Sayed MA. Chemistry and properties of nanocrystals of different shapes. *Chemical reviews* 2005;105:1025-102.
- [41] Hlaing M, Gebear-Eigzabher B, Roa A, Marciano A, Radu D, Lai C-Y. Absorption and scattering cross-section extinction values of silver nanoparticles. *Optical Materials* 2016;58:439-44.
- [42] Schwerdtfeger P. Absorption, scattering and extinction of light in ice and snow. *Nature* 1969;222:378.
- [43] Schaadt DM, Feng B, Yu ET. Enhanced semiconductor optical absorption via surface plasmon excitation in metal nanoparticles. *Applied Physics Letters* 2005;86:063106.
- [44] de Mello Donegá C. Synthesis and properties of colloidal heteronanocrystals. *Chemical Society Reviews* 2011;40:1512-46.
- [45] Wu N. Plasmonic metal–semiconductor photocatalysts and photoelectrochemical cells: a review. *Nanoscale* 2018;10:2679-96.
- [46] Clavero C. Plasmon-induced hot-electron generation at nanoparticle/metal-oxide interfaces for photovoltaic and photocatalytic devices. *Nature Photonics* 2014;8:95.
- [47] Liu X, Iocozzia J, Wang Y, Cui X, Chen Y, Zhao S, et al. Noble metal–metal oxide nanohybrids with tailored nanostructures for efficient solar energy conversion, photocatalysis and environmental remediation. *Energy & Environmental Science* 2017;10:402-34.
- [48] Cortie MB, McDonagh AM. Synthesis and optical properties of hybrid and alloy plasmonic nanoparticles. *Chemical reviews* 2011;111:3713-35.
- [49] Ray C, Pal T. Recent advances of metal–metal oxide nanocomposites and their tailored nanostructures in numerous catalytic applications. *Journal of Materials Chemistry A* 2017;5:9465-87.
- [50] Liu G, Du K, Xu J, Chen G, Gu M, Yang C, et al. Plasmon-dominated photoelectrodes for solar water splitting. *Journal of Materials Chemistry A* 2017;5:4233-53.
- [51] Jiang N, Zhuo X, Wang J. Active plasmonics: principles, structures, and applications. *Chemical reviews* 2017;118:3054-99.

- [52] Pan H, Heagy MD. Plasmon-enhanced photocatalysis: Ag/TiO<sub>2</sub> nanocomposite for the photochemical reduction of bicarbonate to formic acid. *MRS Advances* 2019;4:425-33.
- [53] Yang X, Wang D. Photocatalysis: from fundamental principles to materials and applications. *ACS Applied Energy Materials* 2018;1:6657-93.
- [54] Browne MP, Sofer Z, Pumera M. Layered and two dimensional metal oxides for electrochemical energy conversion. *Energy & Environmental Science* 2019;12:41-58.
- [55] Tee SY, Win KY, Teo WS, Koh L-D, Liu S, Teng CP, et al. Recent Progress in Energy-Driven Water Splitting. *Advanced Science* 2017;4:1600337.
- [56] Tong H, Ouyang S, Bi Y, Umezawa N, Oshikiri M, Ye J. Nano-photocatalytic materials: possibilities and challenges. *Advanced materials* 2012;24:229-51.
- [57] Ojha K, Saha S, Dagar P, Ganguli AK. Nanocatalysts for hydrogen evolution reactions. *Physical Chemistry Chemical Physics* 2018;20:6777-99.
- [58] Shwetharani R, Sakar M, Fernando C, Binas V, Balakrishna RG. Recent advances and strategies to tailor the energy levels, active sites and electron mobility in titania and its doped/composite analogues for hydrogen evolution in sunlight. *Catalysis Science & Technology* 2019;9:12-46.
- [59] Hisatomi T, Kubota J, Domen K. Recent advances in semiconductors for photocatalytic and photoelectrochemical water splitting. *Chemical Society Reviews* 2014;43:7520-35.
- [60] Chen X, Shen S, Guo L, Mao SS. Semiconductor-based photocatalytic hydrogen generation. *Chemical reviews* 2010;110:6503-70.
- [61] Fujishima A, Honda K. Electrochemical Photolysis of Water at a Semiconductor Electrode. *Nature* 1972;238:37-8.
- [62] Saran R, Curry RJ. Lead sulphide nanocrystal photodetector technologies. *Nature Photonics* 2016;10:81.
- [63] Shin SW, Lee K-H, Park J-S, Kang SJ. Highly transparent, visible-light photodetector based on oxide semiconductors and quantum dots. *ACS applied materials & interfaces* 2015;7:19666-71.
- [64] Tian W, Lu H, Li L. Nanoscale ultraviolet photodetectors based on onedimensional metal oxide nanostructures. *Nano Research* 2015;8:382-405.
- [65] García de Arquer FP, Armin A, Meredith P, Sargent EH. Solution-processed semiconductors for next-generation photodetectors. *Nature Reviews Materials* 2017;2:16100.
- [66] Ingram DB, Linic S. Water splitting on composite plasmonic-metal/semiconductor photoelectrodes: evidence for selective plasmon-induced formation of charge carriers near the semiconductor surface. *Journal of the American Chemical Society* 2011;133:5202-5.
- [67] Choi Y, Kim H-i, Moon G-h, Jo S, Choi W. Boosting up the Low Catalytic Activity of Silver for H<sub>2</sub> Production on Ag/TiO<sub>2</sub> Photocatalyst: Thiocyanate as a Selective Modifier. *ACS Catalysis* 2016;6:821-8.
- [68] Chen B, Chen X, Li R, Fan W, Wang F, Mao B, et al. Flame Reduced TiO<sub>2</sub> Nanorod Arrays with Ag Nanoparticle Decoration for Efficient Solar Water Splitting. *Industrial & Engineering Chemistry Research* 2019;58:4818-27.
- [69] Seh ZW, Liu S, Low M, Zhang S-Y, Liu Z, Mlayah A, et al. Janus Au-TiO<sub>2</sub> Photocatalysts with Strong Localization of Plasmonic Near-Fields for Efficient Visible-Light Hydrogen Generation. *Advanced Materials* 2012;24:2310-4.
- [70] Zhang D, Chen J, Deng P, Wang X, Li Y, Wen T, et al. Hydrogen evolution promotion of Au-nanoparticles-decorated TiO<sub>2</sub> nanotube arrays prepared by dip-loading approach. *Journal of the American Ceramic Society* 2019;102:5873-80.
- [71] Yu W, Yin J, Li Y, Lai B, Jiang T, Li Y, et al. Ag<sub>2</sub>S Quantum Dots as an Infrared Excited Photocatalyst for Hydrogen Production. *ACS Applied Energy Materials* 2019;2:2751-9.
- [72] Schulz K. Linking Land and Soil to Climate Change: The UNCCD in the Context of Global Environmental Governance: Tectum-Verlag; 2011.
- [73] Nagasuna K, Akita T, Fujishima M, Tada H. Photodeposition of Ag<sub>2</sub>S Quantum Dots and Application to Photoelectrochemical Cells for Hydrogen Production under Simulated Sunlight. *Langmuir* 2011;27:7294-300.
- [74] Qing T, Zhang K, Qing Z, Wang X, Long C, Zhang P, et al. Recent progress in copper nanocluster-based fluorescent probing: a review. *Microchimica Acta* 2019;186:670.
- [75] Kodan N, Agarwal K, Mehta BR. All-Oxide  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>/H-TiO<sub>2</sub> Heterojunction Photoanode: A Platform for Stable and Enhanced Photoelectrochemical Performance through Favorable Band Edge Alignment. *The Journal of Physical Chemistry C* 2019;123:3326-35.

- [76] Hilaire S, Süess MJ, Kränzlin N, Bieńkowski K, Solarska R, Augustyński J, et al. Microwave-assisted nonaqueous synthesis of WO<sub>3</sub> nanoparticles for crystallographically oriented photoanodes for water splitting. *Journal of Materials Chemistry A* 2014;2:20530-7.
- [77] Goddeti KC, Lee C, Lee YK, Park JY. Three-dimensional hot electron photovoltaic device with vertically aligned TiO<sub>2</sub> nanotubes. *Scientific Reports* 2018;8:7330.
- [78] Clavero C. Plasmon-induced hot-electron generation at nanoparticle/metal-oxide interfaces for photovoltaic and photocatalytic devices. *Nature Photonics* 2014;8:95.
- [79] Li X, Jia C, Ma B, Wang W, Fang Z, Zhang G, et al. Substrate-induced interfacial plasmonics for photovoltaic conversion. *Scientific Reports* 2015;5:14497.
- [80] Valenti M, Venugopal A, Tordera D, Jonsson MP, Biskos G, Schmidt-Ott A, et al. Hot Carrier Generation and Extraction of Plasmonic Alloy Nanoparticles. *ACS Photonics* 2017;4:1146-52.
- [81] DuChene JS, Sweeny BC, Johnston-Peck AC, Su D, Stach EA, Wei WD. Prolonged Hot Electron Dynamics in Plasmonic-Metal/Semiconductor Heterostructures with Implications for Solar Photocatalysis. *Angewandte Chemie International Edition* 2014;53:7887-91.
- [82] Wu K, Chen J, McBride JR, Lian T. Efficient hot-electron transfer by a plasmon-induced interfacial charge-transfer transition. *Science* 2015;349:632.
- [83] Brongersma ML, Halas NJ, Nordlander P. Plasmon-induced hot carrier science and technology. *Nature Nanotechnology* 2015;10:25.
- [84] Chen HM, Chen CK, Chen C-J, Cheng L-C, Wu PC, Cheng BH, et al. Plasmon Inducing Effects for Enhanced Photoelectrochemical Water Splitting: X-ray Absorption Approach to Electronic Structures. *ACS Nano* 2012;6:7362-72.
- [85] Liu Z, Hou W, Pavaskar P, Aykol M, Cronin SB. Plasmon resonant enhancement of photocatalytic water splitting under visible illumination. *Nano Letters* 2011;11:1111-6.
- [86] Yu S, Kim YH, Lee SY, Song HD, Yi J. Hot-Electron-Transfer Enhancement for the Efficient Energy Conversion of Visible Light. *Angewandte Chemie International Edition* 2014;53:11203-7.
- [87] Brennan LJ, Purcell-Milton F, Salmeron AS, Zhang H, Govorov AO, Fedorov AV, et al. Hot plasmonic electrons for generation of enhanced photocurrent in gold-TiO<sub>2</sub> nanocomposites. *Nanoscale Research Letters* 2015;10:38.
- [88] Robotjazi H, Bahauddin SM, Doiron C, Thomann I. Direct Plasmon-Driven Photoelectrocatalysis. *Nano Letters* 2015;15:6155-61.
- [89] Lee YK, Jung CH, Park J, Seo H, Somorjai GA, Park JY. Surface Plasmon-Driven Hot Electron Flow Probed with Metal-Semiconductor Nanodiodes. *Nano Letters* 2011;11:4251-5.
- [90] Knight MW, Wang Y, Urban AS, Sobhani A, Zheng BY, Nordlander P, et al. Embedding Plasmonic Nanostructure Diodes Enhances Hot Electron Emission. *Nano Letters* 2013;13:1687-92.
- [91] Duque JS, Blandón JS, Riascos H. Localized Plasmon resonance in metal nanoparticles using Mie theory. *Journal of Physics: Conference Series* 2017;850:012017.
- [92] Zhang L, Yu JC, Yip HY, Li Q, Kwong KW, Xu A-W, et al. Ambient Light Reduction Strategy to Synthesize Silver Nanoparticles and Silver-Coated TiO<sub>2</sub> with Enhanced Photocatalytic and Bactericidal Activities. *Langmuir* 2003;19:10372-80.
- [93] Kumar R, Rashid J, Barakat MA. Zero valent Ag deposited TiO<sub>2</sub> for the efficient photocatalysis of methylene blue under UV-C light irradiation. *Colloids and Interface Science Communications* 2015;5:1-4.
- [94] Peng C, Wang W, Zhang W, Liang Y, Zhuo L. Surface plasmon-driven photoelectrochemical water splitting of TiO<sub>2</sub> nanowires decorated with Ag nanoparticles under visible light illumination. *Applied Surface Science* 2017;420:286-95.
- [95] Sang L, Ge H, Sun B. Probing plasmonic Ag nanoparticles on TiO<sub>2</sub> nanotube arrays electrode for efficient solar water splitting. *International Journal of Hydrogen Energy* 2019;44:15787-94.
- [96] Wang B, Cao J-T, Dong Y-X, Liu F-R, Fu X-L, Ren S-W, et al. An in situ electron donor consumption strategy for photoelectrochemical biosensing of proteins based on ternary Bi<sub>2</sub>S<sub>3</sub>/Ag<sub>2</sub>S/TiO<sub>2</sub> NT arrays. *Chemical Communications* 2018;54:806-9.
- [97] Zhang H, Wang G, Chen D, Lv X, Li J. Tuning Photoelectrochemical Performances of Ag-TiO<sub>2</sub> Nanocomposites via Reduction/Oxidation of Ag. *Chemistry of Materials* 2008;20:6543-9.
- [98] Chen K, Feng X, Hu R, Li Y, Xie K, Li Y, et al. Effect of Ag nanoparticle size on the photoelectrochemical properties of Ag decorated TiO<sub>2</sub> nanotube arrays. *Journal of Alloys and Compounds* 2013;554:72-9.

- [99] Xie K, Sun L, Wang C, Lai Y, Wang M, Chen H, et al. Photoelectrocatalytic properties of Ag nanoparticles loaded TiO<sub>2</sub> nanotube arrays prepared by pulse current deposition. *Electrochimica Acta* 2010;55:7211-8.
- [100] Chen X, Mao SS. Titanium dioxide nanomaterials: synthesis, properties, modifications, and applications. *Chemical reviews* 2007;107:2891-959.
- [101] Bai Y, Mora-Sero I, De Angelis F, Bisquert J, Wang P. Titanium dioxide nanomaterials for photovoltaic applications. *Chemical reviews* 2014;114:10095-130.
- [102] Dahl M, Liu Y, Yin Y. Composite titanium dioxide nanomaterials. *Chemical reviews* 2014;114:9853-89.
- [103] Ma Y, Wang X, Jia Y, Chen X, Han H, Li C. Titanium dioxide-based nanomaterials for photocatalytic fuel generations. *Chemical reviews* 2014;114:9987-10043.
- [104] Schneider J, Matsuoka M, Takeuchi M, Zhang J, Horiuchi Y, Anpo M, et al. Understanding TiO<sub>2</sub> Photocatalysis: Mechanisms and Materials. *Chemical Reviews* 2014;114:9919-86.
- [105] Moniz SJA, Shevlin SA, Martin DJ, Guo Z-X, Tang J. Visible-light driven heterojunction photocatalysts for water splitting – a critical review. *Energy & Environmental Science* 2015;8:731-59.
- [106] Harbich W, Monot R, Buttet J, Kern K. Controlled Deposition of Size-Selected Silver Nanoclusters. *SCIENCE* 1996;74:8.
- [107] Valden M, Lai X, Goodman DW. Onset of catalytic activity of gold clusters on titania with the appearance of nonmetallic properties. *science* 1998;281:1647-50.
- [108] Neyts EC, Ostrikov K, Sunkara MK, Bogaerts A. Plasma catalysis: synergistic effects at the nanoscale. *Chemical reviews* 2015;115:13408-46.
- [109] Tanaka A, Sakaguchi S, Hashimoto K, Kominami H. Preparation of Au/TiO<sub>2</sub> with metal cocatalysts exhibiting strong surface plasmon resonance effective for photoinduced hydrogen formation under irradiation of visible light. *Acs Catalysis* 2013;3:79-85.
- [110] Bamwenda GR, Tsubota S, Nakamura T, Haruta M. Photoassisted hydrogen production from a water-ethanol solution: a comparison of activities of Au/TiO<sub>2</sub> and Pt/TiO<sub>2</sub>. *Journal of Photochemistry and Photobiology A: Chemistry* 1995;89:177-89.
- [111] Liu G, Schulmeyer T, Thissen A, Klein A, Jaegermann W. In situ preparation and interface characterization of TiO<sub>2</sub>/Cu<sub>2</sub>S heterointerface. *Applied Physics Letters* 2003;82:2269-71.
- [112] Falkowski JM, Surendranath Y. Metal Chalcogenide Nanofilms: Platforms for Mechanistic Studies of Electrocatalysis. *ACS Catalysis* 2015;5:3411-6.
- [113] Park J-H, Ramasamy P, Kim S, Kim YK, Ahilan V, Shanmugam S, et al. Hybrid metal–Cu<sub>2</sub>S nanostructures as efficient co-catalysts for photocatalytic hydrogen generation. *Chemical Communications* 2017;53:3277-80.
- [114] Gao M-R, Jiang J, Yu S-H. Solution-Based Synthesis and Design of Late Transition Metal Chalcogenide Materials for Oxygen Reduction Reaction (ORR). *Small* 2012;8:13-27.
- [115] Qian S, Wang C, Liu W, Zhu Y, Yao W, Lu X. An enhanced CdS/TiO<sub>2</sub> photocatalyst with high stability and activity: Effect of mesoporous substrate and bifunctional linking molecule. *Journal of Materials Chemistry* 2011;21:4945-52.
- [116] He H, Lin J, Fu W, Wang X, Wang H, Zeng Q, et al. MoS<sub>2</sub>/TiO<sub>2</sub> edge-on heterostructure for efficient photocatalytic hydrogen evolution. *Advanced Energy Materials* 2016;6:1600464.
- [117] Yu Y-X, Pan L, Son M-K, Mayer MT, Zhang W-D, Hagfeldt A, et al. Solution-processed Cu<sub>2</sub>S photocathodes for photoelectrochemical water splitting. *ACS Energy Letters* 2018;3:760-6.
- [118] Säuberlich F, Klein A. Band alignment at oxide semiconductor interfaces. *MRS Online Proceedings Library Archive* 2003;763.
- [119] Riha SC, Schaller RD, Gosztola DJ, Wiederrecht GP, Martinson ABF. Photoexcited Carrier Dynamics of Cu<sub>2</sub>S Thin Films. *The Journal of Physical Chemistry Letters* 2014;5:4055-61.
- [120] Tang L, Deng Y, Zeng G, Hu W, Wang J, Zhou Y, et al. CdS/Cu<sub>2</sub>S co-sensitized TiO<sub>2</sub> branched nanorod arrays of enhanced photoelectrochemical properties by forming nanoscale heterostructure. *Journal of Alloys and Compounds* 2016;662:516-27.
- [121] Reyes-Coronado D, Rodriguez Gattorno G, Espinosa Pesqueira M, de Coss R, Oskam G. Phase-Pure TiO<sub>2</sub> Nanoparticles: Anatase, Brookite and Rutile. *Nanotechnology* 2008;19:145605.
- [122] Huang H, Li F, Wang H, Zheng X. The size controlled synthesis of Cu<sub>2</sub>S/P<sub>25</sub> hetero junction solar-energy-materials and their applications in photocatalytic degradation of dyes. *RSC Advances* 2017;7:50056-63.

- [123] Rao VN, Reddy NL, Kumari MM, Ravi P, Sathish M, Kuruvilla K, et al. Photocatalytic recovery of H<sub>2</sub> from H<sub>2</sub>S containing wastewater: Surface and interface control of photo-excitons in Cu<sub>2</sub>S@TiO<sub>2</sub> core-shell nanostructures. *Applied Catalysis B: Environmental* 2019;254:174-85.
- [124] Ding S, Yin X, Lü X, Wang Y, Huang F, Wan D. One-Step High-Temperature Solvothermal Synthesis of TiO<sub>2</sub>/Sulfide Nanocomposite Spheres and Their Solar Visible-Light Applications. *ACS Applied Materials & Interfaces* 2012;4:306-11.
- [125] An L, Zhou P, Yin J, Liu H, Chen F, Liu H, et al. Phase Transformation Fabrication of a Cu<sub>2</sub>S Nanoplate as an Efficient Catalyst for Water Oxidation with Glycine. *Inorganic Chemistry* 2015;54:3281-9.
- [126] Yadav SK, Jeevanandam P. Synthesis of Ag<sub>2</sub>S–TiO<sub>2</sub> nanocomposites and their catalytic activity towards rhodamine B photodegradation. *Journal of Alloys and Compounds* 2015;649:483-90.
- [127] Bessekhoud Y, Brahimi R, Hamdini F, Trari M. Cu<sub>2</sub>S/TiO<sub>2</sub> heterojunction applied to visible light Orange II degradation. *Journal of Photochemistry and Photobiology A: Chemistry* 2012;248:15-23.
- [128] Linsebigler AL, Lu G, Yates JT. Photocatalysis on TiO<sub>2</sub> Surfaces: Principles, Mechanisms, and Selected Results. *Chemical Reviews* 1995;95:735-58.
- [129] Anantharaj S, Ede SR, Karthick K, Sam Sankar S, Sangeetha K, Karthik PE, et al. Precision and correctness in the evaluation of electrocatalytic water splitting: revisiting activity parameters with a critical assessment. *Energy & Environmental Science* 2018;11:744-71.
- [130] Warheit DB, Webb TR, Reed KL, Frerichs S, Sayes CM. Pulmonary toxicity study in rats with three forms of ultrafine-TiO<sub>2</sub> particles: Differential responses related to surface properties. *Toxicology* 2007;230:90-104.
- [131] Gaya UI, Abdullah AH. Heterogeneous photocatalytic degradation of organic contaminants over titanium dioxide: A review of fundamentals, progress and problems. *Journal of Photochemistry and Photobiology C: Photochemistry Reviews* 2008;9:1-12.
- [132] Liu T, Liu B, Yang L, Ma X, Li H, Yin S, et al. RGO/Ag<sub>2</sub>S/TiO<sub>2</sub> ternary heterojunctions with highly enhanced UV-NIR photocatalytic activity and stability. *Applied Catalysis B: Environmental* 2017;204:593-601.
- [133] Neves MC, Nogueira JMF, Trindade T, Mendonça MH, Pereira MI, Monteiro OC. Photosensitization of TiO<sub>2</sub> by Ag<sub>2</sub>S and its catalytic activity on phenol photodegradation. *Journal of Photochemistry and Photobiology A: Chemistry* 2009;204:168-73.
- [134] Shan Z, Clayton D, Pan S, Archana PS, Gupta A. Visible Light Driven Photoelectrochemical Properties of Ti@TiO<sub>2</sub> Nanowire Electrodes Sensitized with Core–Shell Ag@Ag<sub>2</sub>S Nanoparticles. *The Journal of Physical Chemistry B* 2014;118:14037-46.
- [135] Ghafoor S, Ata S, Mahmood N, Arshad SN. Photosensitization of TiO<sub>2</sub> nanofibers by Ag<sub>2</sub>S with the synergistic effect of excess surface Ti<sup>3+</sup> states for enhanced photocatalytic activity under simulated sunlight. *Scientific Reports* 2017;7:255.
- [136] Bao H, Zhang H, Zhou L, Fu H, Liu G, Li Y, et al. Large Area α-Cu<sub>2</sub>S Particle-Stacked Nanorod Arrays by Laser Ablation in Liquid and Their Strong Structurally Enhanced and Stable Visible Photoelectric Performances. *ACS Applied Materials & Interfaces* 2018;10:19027-36.
- [137] Di T, Cheng B, Ho W, Yu J, Tang H. Hierarchically CdS–Ag<sub>2</sub>S nanocomposites for efficient photocatalytic H<sub>2</sub> production. *Applied Surface Science* 2019;470:196-204.
- [138] Yang X, Xue H, Xu J, Huang X, Zhang J, Tang Y-B, et al. Synthesis of Porous ZnS:Ag<sub>2</sub>S Nanosheets by Ion Exchange for Photocatalytic H<sub>2</sub> Generation. *ACS Applied Materials & Interfaces* 2014;6:9078-84.
- [139] Anantharaj S, Ede SR, Sakthikumar K, Karthick K, Mishra S, Kundu S. Recent Trends and Perspectives in Electrochemical Water Splitting with an Emphasis on Sulfide, Selenide, and Phosphide Catalysts of Fe, Co, and Ni: A Review. *ACS Catalysis* 2016;6:8069-97.
- [140] Li Y, Chen G, Zhou C, Sun J. A simple template-free synthesis of nanoporous ZnS–In<sub>2</sub>S<sub>3</sub>–Ag<sub>2</sub>S solid solutions for highly efficient photocatalytic H<sub>2</sub> evolution under visible light. *Chemical Communications* 2009:2020-2.
- [141] Enesca A, Isac L, Duta A. Hybrid structure comprised of SnO<sub>2</sub>, ZnO and Cu<sub>2</sub>S thin film semiconductors with controlled optoelectric and photocatalytic properties. *Thin Solid Films* 2013;542:31-7.
- [142] Shoaib A, Ji M, Qian H, Liu J, Xu M, Zhang J. Noble metal nanoclusters and their in situ calcination to nanocrystals: Precise control of their size and interface with TiO<sub>2</sub> nanosheets and their versatile catalysis applications. *Nano Research* 2016;9:1763-74.
- [143] Low J, Yu J, Jaroniec M, Wageh S, Al-Ghamdi AA. Heterojunction Photocatalysts. *Advanced Materials* 2017;29:1601694.

- [144] Yang Z, Li J, Cheng F, Chen Z, Dong X. BiOBr/protonated graphitic C<sub>3</sub>N<sub>4</sub> heterojunctions: intimate interfaces by electrostatic interaction and enhanced photocatalytic activity. *Journal of Alloys and Compounds* 2015;634:215-22.
- [145] Sun L, Qi Y, Jia C-J, Jin Z, Fan W. Enhanced visible-light photocatalytic activity of gC<sub>3</sub>N<sub>4</sub>/Zn<sub>2</sub>GeO<sub>4</sub> heterojunctions with effective interfaces based on band match. *Nanoscale* 2014;6:2649-59.
- [146] Li R, Weng Y, Zhou X, Wang X, Mi Y, Chong R, et al. Achieving overall water splitting using titanium dioxide-based photocatalysts of different phases. *Energy & Environmental Science* 2015;8:2377-82.
- [147] Li Z, Xiong S, Wang G, Xie Z, Zhang Z. Role of Ag<sub>2</sub>S coupling on enhancing the visible-light-induced catalytic property of TiO<sub>2</sub> nanorod arrays. *Scientific reports* 2016;6:19754.
- [148] Hu H, Ding J, Zhang S, Li Y, Bai L, Yuan N. Photodeposition of Ag<sub>2</sub>S on TiO<sub>2</sub> nanorod arrays for quantum dot-sensitized solar cells. *Nanoscale research letters* 2013;8:10.
- [149] Gholami M, Qorbani M, Moradlou O, Naseri N, Moshfegh AZ. Optimal Ag<sub>2</sub>S nanoparticle incorporated TiO<sub>2</sub> nanotube array for visible water splitting. *RSC Advances* 2014;4:7838-44.
- [150] Gao Y, Masuda Y, Peng Z, Yonezawa T, Koumoto K. Room temperature deposition of a TiO<sub>2</sub> thin film from aqueous peroxotitanate solution. *Journal of Materials Chemistry* 2003;13:608-13.
- [151] Ong WL, Lim Y-F, Ong JLT, Ho GW. Room temperature sequential ionic deposition (SID) of Ag<sub>2</sub>S nanoparticles on TiO<sub>2</sub> hierarchical spheres for enhanced catalytic efficiency. *Journal of Materials Chemistry A* 2015;3:6509-16.
- [152] Yu H, Liu W, Wang X, Wang F. Promoting the interfacial H<sub>2</sub>-evolution reaction of metallic Ag by Ag<sub>2</sub>S cocatalyst: A case study of TiO<sub>2</sub>/Ag-Ag<sub>2</sub>S photocatalyst. *Applied Catalysis B: Environmental* 2018;225:415-23.
- [153] Konstantatos G, Sargent EH. Nanostructured materials for photon detection. *Nature* 2010;5:391.
- [154] Saran R, Curry RJ. Lead sulphide nanocrystal photodetector technologies. *Nat Photon* 2016;10:81-92.
- [155] Clifford JP, Konstantatos G, Johnston KW, Hoogland S, Levina L, Sargent EH. Fast, sensitive and spectrally tuneable colloidal-quantum-dot photodetectors. *Nat Nano* 2009;4:40-4.
- [156] Yao J, Zheng Z, Yang G. All-Layered 2D Optoelectronics: A High-Performance UV-vis-NIR Broadband SnSe Photodetector with Bi<sub>2</sub>Te<sub>3</sub> Topological Insulator Electrodes. *Advanced Functional Materials* 2017;27:1701823.
- [157] Kumar Y, Kumar H, Rawat G, Kumar C, Pal BN, Jit S. Spectrum Selectivity and Responsivity of ZnO Nanoparticles Coated Ag/ZnO QDs/Ag UV Photodetectors. *IEEE Photonics Technology Letters* 2018;30:1147-50.
- [158] Kumar H, Kumar Y, Rawat G, Kumar C, Mukherjee B, Pal BN, et al. Electrical and optical characteristics of solution-processed MoO<sub>x</sub> and ZnO QDs heterojunction. *MRS Communications* 2017;7:607-12.
- [159] McDonald SA, Konstantatos G, Zhang S, Cyr PW, Klem EJD, Levina L, et al. Solution-processed PbS quantum dot infrared photodetectors and photovoltaics. *Nat Mater* 2005;4:138-42.
- [160] Szendrei K, Cordella F, Kovalenko MV, Böberl M, Hesser G, Yarema M, et al. Solution-Processable Near-IR Photodetectors Based on Electron Transfer from PbS Nanocrystals to Fullerene Derivatives. *Advanced Materials* 2009;21:683-7.
- [161] Xia F, Mueller T, Lin Y-m, Valdes-Garcia A, Avouris P. Ultrafast graphene photodetector. *Nature Nanotechnology* 2009;4:839.
- [162] Yao J, Shao J, Wang Y, Zhao Z, Yang G. Ultra-broadband and high response of the Bi<sub>2</sub>Te<sub>3</sub>-Si heterojunction and its application as a photodetector at room temperature in harsh working environments. *Nanoscale* 2015;7:12535-41.
- [163] Kumar Y, Kumar H, Mukherjee B, Rawat G, Kumar C, Pal BN, et al. Visible-Blind Au/ZnO Quantum Dots-Based Highly Sensitive and Spectrum Selective Schottky Photodiode. *IEEE Transactions on Electron Devices* 2017;64:2874-80.
- [164] Mueller T, Xia F, Avouris P. Graphene photodetectors for high-speed optical communications. *Nature Photonics* 2010;4:297.
- [165] Armin A, Jansen-van Vuuren RD, Kopidakis N, Burn PL, Meredith P. Narrowband light detection via internal quantum efficiency manipulation of organic photodiodes. *Nature Communications* 2015;6:6343.
- [166] Bernacka-Wojcik I, Senadeera R, Wojcik PJ, Silva LB, Doria G, Baptista P, et al. Inkjet printed and "doctor blade" TiO<sub>2</sub> photodetectors for DNA biosensors. *Biosensors and Bioelectronics* 2010;25:1229-34.

- [167] Saran R, Curry RJ. Lead sulphide nanocrystal photodetector technologies. *Nature Photonics* 2016;10:81.
- [168] Ismail RA, Al-Samarai A-ME, Muhammed AM. High-performance nanostructured p-Cu<sub>2</sub>S/n-Si photodetector prepared by chemical bath deposition technique. *Journal of Materials Science: Materials in Electronics* 2019;30:11807-18.
- [169] Martinuzzi S, Sarti D, Vassilevski D, Zapien-Nataren F. Photodetection properties of Cu<sub>2</sub>S/CdS heterojunction solar cells. *Solar Cells* 1980;2:173-84.
- [170] Pan C, Niu S, Ding Y, Dong L, Yu R, Liu Y, et al. Enhanced Cu<sub>2</sub>S/CdS Coaxial Nanowire Solar Cells by Piezo-Phototronic Effect. *Nano Letters* 2012;12:3302-7.
- [171] Su Y, Lu X, Xie M, Geng H, Wei H, Yang Z, et al. A one-pot synthesis of reduced graphene oxide–Cu<sub>2</sub>S quantum dot hybrids for optoelectronic devices. *Nanoscale* 2013;5:8889-93.
- [172] Maity P, Singh SV, Biring S, Pal BN, Ghosh AK. Selective near-infrared (NIR) photodetectors fabricated with colloidal CdS:Co quantum dots. *Journal of Materials Chemistry C* 2019.
- [173] Wu C-Y, Pan Z-Q, Liu Z, Wang Y-Y, Liang F-X, Yu Y-Q, et al. Controllable synthesis of p-type Cu<sub>2</sub>S nanowires for self-driven NIR photodetector application 2017.