



Materials Science and Engineering

2020 Annual Report

Yun Hang Hu

Charles and Carroll McArthur Endowed Chair Professor

This is the 2020 annual report for the Charles and Carroll McArthur endowed professorship. The endowed professorship has provided a great support for my research, which created remarkable achievements in 2020 as follows:

➤ **National and International Recognitions in 2020**

- 1) **Elected Fellow**, American Physical Society (APS)
- 2) **Elected Fellow**, American Chemical Society (ACS)
- 3) **Elected Fellow**, ASM International (ASM)
- 4) **Distinguished Service Award**, American Chemical Society (ACS)

➤ **Research highlights in 2020**

We made great research efforts in solar energy, hydrogen energy, carbon nanomaterials, and electrodes for energy devices, leading to 30 papers published in prestigious journals and 1 invited keynote talk in an international conference, such as:

- Z. Sun, S. Fang, Y. H. Hu*, “3D Graphene Materials: From Understanding to Design and Synthesis Control”, *Chem. Rev.*, **120**, 10336(2020).
- Y. H. Hu* and E. Ruckenstein, “Comment on dry reforming of methane by stable Ni-Mo nanocatalysts on single-crystalline MgO”, *Science* **368**, eabb5459(2020).
- Z. Sun, Y. H. Hu*, “How Magical Is Magic-Angle Graphene?”, *Matter* **2**, 1106(2020).
- Z. Sun, Y. H. Hu*, “Ultrafast, Low-Cost, and Mass Production of High-Quality Graphene”, *Angew. Chem. Int. Ed.*, **59**, 9232 (2020).
- H. Su, Y. H. Hu*, “Progress in low-temperature solid oxide fuel cells with hydrocarbon fuels”, *Chem. Eng. J.* **402**, 126235(2020).
- S. Fang, Y. Liu, Z. Sun, J. Long, C. Bao, Y. H. Hu*, “Photocatalytic hydrogen production over Rh-loaded TiO₂: What is the origin of hydrogen and how to achieve hydrogen production from water?”, *Appl. Catal. B* **278**, 119316(2020).
- C. Wang, S. Fang, S. Xie, Y. Zheng, Y. H. Hu*, “Thermo-photo catalytic CO₂ hydrogenation over Ru/TiO₂”, *J. Mater. Chem. A* **8**, 7390(2020).
- X. Zou, Z. Sun, Y. H. Hu*, “g-C₃N₄-based photoelectrodes for photoelectrochemical water splitting: a review”, *J. Mater. Chem. A* **8**, 21474 (2020).
- F. Pan, B. Li, E. Sarnello, Y. Fei, X. Feng, Y. Gang, X. Xiang, L. Fang, T. Li, Y. H. Hu, G. Wang, Y. Li *, “Pore-Edge Tailoring of Single-Atom Iron-Nitrogen Sites on Graphene for Enhanced CO₂ Reduction”, *ACS Catal.* **10**, 10803(2020).



- Y. Fei, S. Fang, Y. H. Hu*, “Synthesis, properties and potential applications of hydrogenated graphene”, *Chem. Eng. J.*, **397**, 125408 (2020).
- J. Lang, Y. Ma, X. Wu, Y. H. Hu*, “Highly efficient light-driven methane coupling under ambient conditions based on an integrated design of a photocatalytic system”, *Green Chem.* **22**, 4669 (2020).
- L. Wang, J. Deng, J. Deng, Y. Fei, Y. Fang, Y. H. Hu*, “Ultra-fast and ultra-long-life Li ion batteries with 3D surface-porous graphene anodes synthesized from CO₂”, *J. Mater. Chem. A* **8**, 13385 (2020).
- F. Pan, B. Li, E. Sarnello, Y. Fei, Y. Gang, X. Xiang, Z. Du, P. Zhang, G. Wang, H. Nguyen, T. Li, Y. H. Hu, H. C. Zhou, Y. Li*, “Atomically Dispersed Iron-Nitrogen Sites on Hierarchically Mesoporous Carbon Nanotube and Graphene Nanoribbon Networks for CO₂ Reduction”, *ACS Nano* **14**, 5506(2020).
- J. Deng, L. Wang, J. Deng, Y. Fang, Y. Lin, Y. H. Hu*, “Ultrahigh-rate lithium-ion batteries with 3D fungus-structured carbon/CuC₂O₄ center dot xH₂O electrodes”, *J. Mater. Chem. A* **8**, 3397-3404(2020).
- B. Zhu, J. Lang, Y. H. Hu*, “S-Vacancy induced indirect-to-direct band gap transition in multilayer MoS₂”, *Phys Chem Chem Phys.* **22**, 26005 (2020).
- Y. Jiang, J. Lang, X. Wu, Y. H. Hu*, “Electronic structure modulating for supported Rh catalysts toward CO₂ methanation”, *Catal. Today* **356**, 570 (2020).
- Y. Ma, Y. H. Hu*, “Efficient Ni(OH)₂/WO₃ Photoanode for Photoelectrocatalytic Water Splitting at Low Bias”, *J. Phys. Chem. C*, **124**, 19447(2020).
- Y. Gang, F. Pan, Y. Fei, Z. C. Du, Y. H. Hu, Y. Li*, “Highly Efficient Nickel, Iron, and Nitrogen Codoped Carbon Catalysts Derived from Industrial Waste Petroleum Coke for Electrochemical CO₂ Reduction”, *ACS Sustainable Chem. Eng.*, **8**, 8840 (2020).
- D. Wang, W. Wei, Y. H. Hu*, “Highly Efficient Dye-Sensitized Solar Cells with Compositated Food Dyes”, *Ind. Eng. Chem. Res.* **59**, 10447(2020).
- J. Lang, Y. H. Hu*, “Phosphorus-based metal-free Z-scheme 2D van der Waals heterostructures for visible-light photocatalytic water splitting: a first-principles study”, *Phys Chem Chem Phys.* **22**, 9250 (2020).
- S. Wu, H. Hu, Y. Lin, Y. H. Hu*, “Visible light photocatalytic degradation of tetracycline over TiO₂”, *Chem. Eng. J.* **382**, 122842(2020).
- Y. Lin, H. Hu, Y. H. Hu*, “Role of ZnO morphology in its reduction and photocatalysis”, *Appl. Surf. Sci.* **502**, 144202 (2020).

➤ Highlights for Hu’s Graduate Students

Two graduate students graduated with MSc and PhD degrees, respectively.