# Bin Zhu

*China University of Geosciences, China*

**Semiconductors and semiconductor ionic hetero-structure composites for next generation energy conversion technology**

Conventionally ionic conductivity has been developed by ionic conducting materials but challenge unsolved. Typically, solid oxide fuel cell (SOFC), yttrium stabilized zirconia (YSZ) electrolyte, which needs high operational temperature above 700°C to reach required ionic conductivity, for SOFC technology over several decades has not yet been commercialized. The same challenge is faced for next generation solid battery technologies. Semiconductor-ionic materials are new functional material family with superionic conduction developed by semiconductors or their heterostructure materials with wide energy applications.

The band structure, p-n junction and build-in-field have been discovered to facilitate fast ionic transport. Tuning semiconductors and heterostructures to ionic conductors is a very effective approach to develop superionic conductivities and novel energy devices. For example, fuel cells built on anode, electrolyte and cathode can now be constructed by semiconductor-ionic heterostructures to realize more efficiently the fuel cell hydrogen oxidation reaction (HOR) and oxygen reduction reaction (ORR) through band structure and alignment without using the electrolyte separator. The novel ceramic fuel cells based on semiconductor-based membranes instead of conventional electrolyte have been demonstrated with excellent power outputs at temperatures between 400-550°C.

Numerous amounts of semiconductor-ionic materials have been explored and novel fuel cell technologies have been demonstrated. Some examples are bulk hetero p-n junction and Schottky junction for single layer fuel cells, designed by energy bands and alignments. New disciplines of Semiconductor-Ionics and Semiconductor Electrochemistry have been establishing not only for energy conversion, e.g. fuel cells, but also for energy storage devices like batteries.

## Speaker Biography

Bin Zhu received M.Sc., in 1987 from University of Sci. & Tech. of China and PhD in 1995 from Chalmers University of Technology, Physics and Engineering Physics, Sweden and during 10/ 95-12/97 worked as Postdoc. in Uppsala University (in Ångström Lab). Since 1998, Zhu moved to KTH and in 1999 became associate professor in Dept of Chemical Engineering and Technology, and now in Dept of Energy Technology, KTH. He is visiting professor in Aalto University and Nanyang Technological University as well as in several Chinese universities to co-supervise research projects and PhD students. From 2018, Zhu has been appointed as visiting professor position in Loughborough University, UK. Zhu has more than 300 publications in nano-composites and new semiconductor-ionic materials for advanced fuel cells from material to device, technology for scaling up into polygeneration systems, e.g. in fuel cells, innovations made on low temperature, 300-600°C SOFCs, electrolyte (layer)-free fuel cell (EFFC), single layer fuel cells (SLFCs), semiconductor-based fuel cell as next generation high-efficient fuel-to-electricity conversion. He has also devoted to establish frontier disciplinary of Semiconductor-Ionics and Semiconductor Electrochemistry for fuel cells and other energy storage devices, e.g. solid batteries.

**e:** binzhu@kth.se

*Notes:*