ZHIFENG REN

Director, Texas Center for Superconductivity at the University of Houston

RESEARCH INTERESTS

Superconductivity: synthesis and characterizations of new superconductors; *High performance thermoelectric materials*: nanostructure approach to reduce thermal conductivity and to improve thermoelectric properties for waste heat conversion into electricity; *Catalysts for water splitting*: synthesis and testing of efficient catalysts for hydrogen and oxygen evolution reactions; *Nanosheets for enhanced oil recovery*: synthesis and characterizations of high performance nanosheet for enhanced oil recovery; *Thermal management*: efficient cooling materials, thermal storage, high thermal conductivity; *Flexible transparent electrodes*: fabrication and understanding of flexible transparent electrodes; *etc*.

EDUCATION

Sichuan Institute of Technology	Mechanical Engineering	B. S., 1984
Huazhong University of Science and Technology	Materials Science	M. S., 1987
Institute of Physics, Chinese Academy of Sciences	Condensed Matter Physics	Ph.D., 1990

SELECTED HONORS/AWARDS

Fellow of the American Physical Society	2004
Fellow of the American Association for the Advancement of Science	2005
Distinguished Senior Research Award of Boston College	2006
R&D 100 Award for the development of high performance thermoelectric materials	2008
Ranked as the 49th of the world's top 100 Materials Scientists of the decade 2000-2010	2011
Fellow of the National Academy of Inventors	2013
The Edith and Peter O'Donnell Award in Science from The Academy of Medicine, Engineering & Science of Texas (TAMEST)	2014
Excellence in Research, Scholarship and Creative Activity of UH (Full Professor)	2018

PROFESSIONAL ACTIVITIES

Editor-in-Chief: "Materials Today Physics"	2017-present
Associate Editor: "Materials Today Nano"	2018-present
Editorial Board: "Research", a Science Partner Journal	2018-present
Editorial Board: "npj Quantum Materials"	2016-present
Editorial Board: "Materiomics"	2014-present
Editorial Board: "Progress in Physics"	2009-present

EXPERIENCE

Director, Texas Center for Superconductivity at the University of Houston		University of Houston	2018-present
MD Anderson Chair Professor	Physics	University of Houston	2013-present
Professor	Physics	Boston College	2004-2013
Associate Professor	Physics	Boston College	1999-2004
Research Associate Professor	Chemistry	SUNY at Buffalo	1998-1999
Research Assistant Professor	Chemistry	SUNY at Buffalo	1995-1998
Research Scientist	Chemistry	SUNY at Buffalo	1992-1995
Postdoctoral Fellow	Chemistry	SUNY at Buffalo	1990-1992

Ren has published 480 papers in peer-reviewed journals, and has 47 issued patents and 5 spinoff companies.

See https://mynsm.uh.edu/wiki/pages/s4p050e/Professor_Zhifeng_Ren.html or

https://scholar.google.com/citations?user=uVxFD-sAAAAJ&hl=en

ZHIFENG REN

Research

Zhifeng Ren, Director of the Texas Center for Superconductivity at the University of Houston and M.D. Anderson Chair Professor of Physics in the College of Natural Sciences and Mathematics, conducts cutting-edge research in a number of fields, including high temperature superconductivity, carbon nanotubes, ZnO nanowires, thermoelectrics, solar absorbers, flexible transparent conductors, enhanced oil recovery, water splitting, high thermal conductivity materials BAs, *etc*. His pivotal contributions to each of these fields have been widely recognized.

In the field of high temperature superconductivity, Ren made the high-quality high Tc superconducting thallium-based thin films on tricrystal and tetracrystal substrates for the decisive determination of electron paring symmetry in high Tc materials. The pairing symmetry measurements on the thin films were carried out by Dr. C. C. Tsuei *et al.* at IBM, which led to one paper in *Science* and two papers in *Nature*. Due to the significance of the work, Tsuei *et al*. were rewarded with the Buckley Prize in 1998, the highest honor in condensed matter physics.

For carbon nanotubes, he pioneered the growth technique for making aligned carbon nanotube arrays, which opened up a new field on "alignment, physics, and applications of carbon nanotubes". This work was published in *Science* in 1998 and has drawn international attention. The follow-up work on these aligned carbon nanotubes led to the discovery of aligned carbon nanotubes as nano antenna to interact with visible light, which led to the first demonstration of light absorption and transmission in subwavelength in a coaxial cable that might be the principle for the most efficient solar cells.

For the study on thermoelectric materials, Ren's group has broken the record of thermoelectric figure-of-merit (ZT) of Bismuth Antimony Telluride that was set in the 1950s by using a cheap, scalable "ball milling and hot pressing" process. The essence was to create nano structures and then consolidate them into dense bulk form containing nano structures. The work was published in *Science* as a Research Article in 2008. Subsequent work has proved that the process is applicable to many other materials systems.

Oil exploration and drilling is expensive, and therefore, development of cost effective methods to increase the oil extraction rate is extremely important. At present, chemicals are used to increase the oil extraction rate, but with environmental consequences. Ren's group has recently made new "nanosheets" that can extract oil three times that of the current method while eliminating negative environmental effects. Commercialization of the technology is underway with the goal of extracting hundreds of millions of extra barrels of oil per year.

Water splitting to produce hydrogen to store the large amount of oversupplied electrical power during the off-peak hours by electrolysis needs very efficient and cheap electrocatalysts. During the past few years, Ren's group has discovered a few outstanding catalysts that can split water just as efficient as the noble metals such as Pt, IrO_2, *etc*. This work will contribute very significantly to the hydrogen economy.

Very recently, Ren's group has successfully grown large samples of boron arsenide (BAs) single crystals, demonstrating thermal conductivity higher than 1000 W m^{-1} K^{-1} at room temperature for the first time. The work on this "thermal superconductor" was published in *Science* on July 5, 2018. Such a high thermal conductivity is extremely important to keep high power electronic devices, and many other applications, cool. It is also expected that BAs will be better semiconductors than the current silicon due to its wider band gap and higher mobility, leading to next-generation, life-changing applications when made into everyday electronic devices.

Ren has published almost 500 papers, many of which have high impact to the fields. His discoveries have been awarded with more than 40 US Patents. He was ranked the 49th of the world's 500,000 Materials Scientists based on impact of papers published in the last decade from 2000 to 2010. He was elected as a fellow of the American Physical Society in 2004, a fellow of the American Association for the Advancement of Science in 2005, and a fellow of the National Academy of Inventors in 2013. He was the recipient of the Edith and Peter O'Donnell Award in Science from The Academy of Medicine, Engineering & Science of Texas (TAMEST) in 2014.