高分子科学系列讲座

高分子物理与化学国家重点实验室 中国科学院长春应用化学研究所

序　　号	PS2013-18	**总 序 号**	PSLAB180-PS2013-18
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从事专业	材料科学与工程、功能材料		
建 议 人	杨小牛　研究员	**主 持 人**	杨小牛　研究员
报告时间	11 月 22 日(星期五) 9:00	**报告地点**	主楼四楼学术会议厅 410 室
单　　位	南方科技大学		
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报告人背景

2003 年本科毕业于南京大学化学系。2004 年开始在美国芝加哥大学化学系攻读研究生，师从 Luping Yu 教授，从事半导体高分子材料研究，并于 2009 年获得哲学博士学位。2009-2012 年在美国斯坦福大学 Hongjie Dai 组进行博士后研究工作，研究方向为碳纳米复合材料。2012 年 9 月加入南方科技大学，担任材料科学与工程系副教授。

当前研究兴趣：以化学设计和合成为基础， 配合器件工艺的协同研究，发展应用于能源采集、存储和转换的高效材料系统。

报告题目

The Power of Materials Chemistry in Meeting Challenges of Energy Research: From Harvesting to Conversion and Storage

内容摘要

Owing to issues of accelerating global energy demand, exhausting of fossil fuel and climate change, energy is amongst the most important challenges facing humanity today. This talk will explore the power of materials chemistry in energy research regarding the development of efficient, cheap and sustainable systems for the harvesting, conversion and storage of renewable energy sources. I will first describe my work in the development of new semiconducting polymers for high performance organic solar cells. We have developed a series of thieno[3,4-b]thiophene based polymers by rational design and demonstrated the first polymer solar cell system showing over 7% efficiency. Our work establishes that efficient photovoltaic polymers can be optimized through fine-tuning the structural and electronic properties of polymer backbone, pointing out the bright future of polymer solar cell as alternative solar energy harvesting materials. The second part focuses on the development of nano-carbon based hybrid materials for energy conversion and storage. In this context, we have developed hybrid material of spinel oxide nanocrystals grown on graphene sheets/carbon nanotubes and found their surprising activities as a bi-functional oxygen electrode catalyst, which are crucial for fuel cell and water splitting. Furthermore, we have fabricated several graphene based hybrids as electrode materials for supercapacitor and lithium-ion battery, affording improved specific capacities and rate performance. Synergetic coupling of functional nanocrystals with nano-carbon materials opens up a new approach to advanced catalysts and electrode materials for energy conversion and storage.

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高分子物理与化学国家重点实验室 中国科学院长春应用化学研究所

序　　号	PS2013-19	**总 序 号**	PSLAB181-PS2013-19
报 告 人	郭旭岗	**职　　称**	博士
从事专业	材料科学与工程、有机电子		
建 议 人	杨小牛　研究员	**主 持 人**	杨小牛　研究员
报告时间	11 月 22 日(星期五) 9:00	**报告地点**	主楼四楼学术会议厅 410 室
单　　位	南方科技大学		
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报告人背景

1999 年本科毕业于兰州大学化学系。2004 年起在美国肯塔基大学化学系攻读研究生，师从 Mark Watson 教授，从事半导体高分子材料合成研究，并于 2009 年获得哲学博士学位。2009-2012 年在美国西北大学 Tobin Marks 组进行博士后研究工作，研究方向为有机电子材料。2012 年 11 月加入南方科技大学，担任材料科学与工程系副教授。

当前研究兴趣：低温可溶液处理的高性能有机电子器件和线路。

报告题目

Imide-Functionalized Polymer Semiconductors for High-Performance Organic Thin-Film Transistors and Solar Cells

内容摘要

Diimide-functionalized arylenes are widely used as n-channel small-molecule semiconductors for applications in organic thin-film transistors and solar cells. Recently, they have been demonstrated to be attractive electron acceptor units for creating high-performance polymer semiconductors with fine tuned bandgaps and frontier molecular orbitals as well as desired film microstructures and morphologies of the resulting polymers.

Here, we present the imide-functionalized polymer semiconductors for applications in high-performance organic thin-film transistors and solar cells. The imide-functionalized aryenes include naphthalene diimide, phthalimide, thiophene imide, and bithiophene imide. By copolymerizing with various electron donor counits, we are able to achieve polymer semiconductors with tunable charge carrier polarities (n-channel, p-channel, and ambipolar). The n-channel polymers show electron mobilities approaching 0.3 cm^2/Vs, and p-channel polymers exhibit hole mobilities around 2 cm^2/V. The inkjet-patterned polymeric CMOS inverters show voltage gains of 40. The substantial charge carrier mobilities, small bandgaps, and low-lying HOMOs enable the imide-functionalized polymers as excellent electron donor layer in organic solar cells. The solar cells show promising power conversion efficiencies with interesting device performance parameters. Bulk heterojunction organic solar cells show unprecedented fill factors of 75-80%, which greatly boost the power conversion efficiency to 8.7% using polymers with moderate bandgap of ~1.80 eV. The physical origins of such high fill factors have been elucidated and the structure-property-device performance correlations of these polymers have been established.