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Advanced Materials Research Institute

Science Bridges China Research Profile

Name: **Chuhong Zhang**

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SUMMARY OF MY RELEVANT RESEARCH AREAS:

polymer based nanocomposites, ionically conducting polymeric materials.

聚合物基纳米复合材料，离子导电聚合物材料

Primary Research interests:

1. Established a novel method to prepare polymer nanocomposites with excellent conducting, magnetic, or optical properties by ultrasonic irradiation. By taking advantages of the multieffect of ultrasound, i.e., dispersion, crushing, activation and initiation, ultrasonic irradiation was first used to realize the polymerization of monomers on the surface of nanoparticles, offering a new route to prepare composites containing stable nanoparticles encapsulated by polymers.(Eur. Polym. J., 38, 1769, 2002; J. of Appl. Polym. Sci., 80, 1478, 2001)

2. Exploring the relationship between the structure and dynamic properties in bulk and nanoparticle filled polymers using neutron scattering, particularly, quasielastic neutron scattering (QENS), and revealing the mechanism of the segmental motions of polymer chains within different temperature ranges as well as the influence of the nanoparticles on the segmental motions.(Phys. Rev. Lett., 90, 058301, 2003; Chem. Phys., 328, 53, 2006)

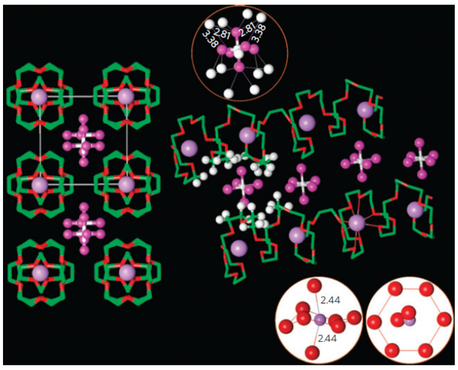
2. Preparing novel solid crystalline polymer electrolytes with high ionic conductivity, investigating their conduction mechanism and application in lithium and sodium ion batteries: reported PEO_8:$NaAsF_6$, the first sodium conducting crystalline polymer electrolyte, which has a conductivity 1.5 orders of magnitude higher than PEO_6:$LiAsF_6$ at 25^{o}C and has been successfully applied in sodium batteries (Nature Materials, 8, 580, 2009); reported a new class of crystalline small-molecule electrolytes which are soft solids but, unlike polymers, are based on short-chain molecules that do not entangle and are monodispersed (Ang. Chem. Int. Ed., 46, 2848, 2007; JACS, 129, 8700, 2007); proved that doping, modifying chain ends, changing molecular weight of polymers etc are efficient ways in enhancing the conductivity of crystalline polymer electrolytes (JACS, 127, 18305, 2005; J. Mater. Chem., 17, 3222,2007).

Topics in which you would like to develop collaborative research:

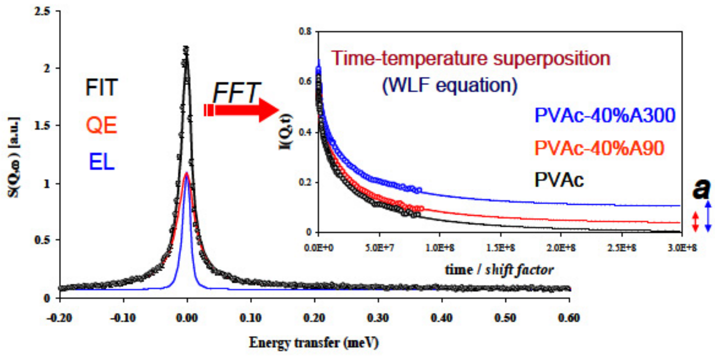
- Polymer nanocomposites used for medical applications
- Polymer solid electrolyte used for Lithium/sodium battery

Relevant existing collaborations (academic/clinical/commercial) inside or outside China.

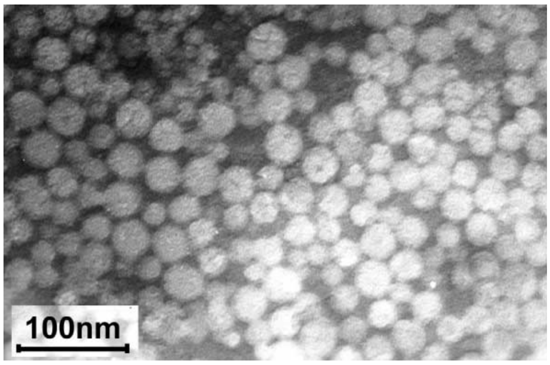
Relevant graphics, figures, pictures:



The first sodium conducting crystalline polymer electrolyte, PEO_8: $NaAsF_6$, which has a conductivity 1.5 orders of magnitude higher than PEO_6:$LiAsF_6$ at 25°C
The structure of PEO_8: $NaAsF_6$, from the single-crystal data collected at 25 °C, Left: view of the complete structure (hydrogens are not shown). Right: fragment of the structure showing neighbouring tunnels with dedicated anions (only hydrogens closest to the leftmost AsF_6^- anion are shown). The circular insets show the immediate environment of the anion and the cation, with the numbers indicating selected F–H and Na–O distances. Purple, sodium; red, oxygen; green, carbon; magenta, fluorine; white (small circle), arsenic; white (large circle), hydrogen
(Chuhong Zhang, Stephen Gamble, David Ainsworth, Alexandra M. Z. Slawin, Yuri G. Andreev and Peter G. Bruce, Nature Materials, 8, 580, 2009)



QENS spectra of PVAc containing 40 wt% A300 as measured on IRIS at 478K and Q = 1.45 $Å^{-1}$, the fit to the experimental data including a quasielastic and an elastic contributions. Inset: overlapped Intermediate scattering function I(Q,t) data of bulk and nanoparticle filled PVAc as well as their fits at 1.58 $Å^{-1}$ (reference temperature: 478 K).



TEM micrograph of PS latex obtained through ultrasonically induced microemulsion polymerization of St (Chuhong Zhang, Qi Wang, Hesheng Xia, Guihua Qiu, European Polymer Journal 38, 1769, 2002)

Publications and other outputs relevant to your interest in this programme (up to 5)

1. Chuhong Zhang, Stephen Gamble, David Ainsworth, Alexandra M. Z. Slawin, Yuri G. Andreev, Peter G. Bruce. "Alkali Metal Crystalline Polymer Electrolytes", Nature Materials, 8, 580, 2009.
2. Chuhong Zhang, Yuri G. Andreev, Peter G. Bruce. "Crystalline Small-Molecule Electrolytes", Angewandte Chemie International Edition, 46, 2848, 2007.
3. Chuhong Zhang, Edward Staunton, Yuri G. Andreev, and Peter G. Bruce. "Raising the Conductivity of Crystalline Polymer Eectrolytes by Aliovalent Doping ", Journal of the American Chemical Society, 127, 18305, 2005.
4. Chuhong Zhang, Valeria Arrighi, Simona Gagliardi, Iain J. McEwen, Jeerachada Tanchawanich, Mark T.F. Telling, J.-M. Zanotti. "Quasielastic Neutron Scattering Measurements of Fast Process and Methyl Group Dynamics in Glassy Poly(vinyl acetate)", Chemical Physics, 328, 53, 2006.
5. Chuhong Zhang, Qi Wang, Hesheng Xia, Guihua Qiu. "Ultrasonically Induced Microemulsion Polymerisation of Styrene", European Polymer Journal, 38, 1769, 2002.