Glass for Energy Storage

A Plenary Talk

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Plenary Speaker's Information

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Biography	Yuanzheng Yue is Professor of Chemistry at Aalborg University, Denmark. In 1995, he obtained his Ph.D. degree in Materials Science from Technical University of Berlin, Germany. In 1998, he established the inorganic glass research area at Aalborg University. His research focuses on glasses, glass fiber, metal-organic framework glasses, metallic glasses, and amorphous materials. He has published over 370 papers in peer-refereed journals including *Nature, Science* and *Nat Mater*. He has delivered 127 invited talks at conferences. He is a council member of the International Commission on Glass (ICG), the founding chair of the ICG Technical Committee for Glass Fibers, and a board member of the Danish Ceramic Society. He serves as an editor for the *European Journal of Glass Science and Technology* and sits on the editorial boards of five other journals. In 2019, he was elected as a fellow of the European Academy of Sciences, followed by fellowships in the Royal Society of Chemistry in 2020, membership in the Danish Academy of Natural Sciences in the same year, and fellowships in both the European Ceramics Society and the Society of Glass Technology (UK) in 2023. He was awarded the Knight's Cross of the Order of the Dannebrog of Denmark in 2014.		
Lecture Title	Glass for Energy Storage		

Lecture Summary	Our society is swiftly progressing towards a greener future, aiming for a more sustainable world. Throughout this process, energy storage devices, such as like rechargeable batteries, are playing a pivotal role in advancing green energy technology. One of these energy storage devices are all-solid-state lithium and sodium-ion batteries (LIBs and NIBs) [1]. While there has been progress in the development of these batteries, there is an urgent need for substantial efforts to enhance their energy density. In this presentation, we demonstrate the potential of glass materials as promising battery components, including anode, cathode, and electrolyte [2-9]. We showcase the recent advances in improving the electrochemical performances of both glassy and crystalline electrode materials by using our order/disorder engineering concept [3-6]. We analyze the structural changes of glassy anodes during the Li/Na intercalation and extraction by performing nuclear magnetic resonance and total x-ray scattering experiments. We elucidate the reasons behind the remarkable cycling-induced capacity enhancement observed in metal-organic framework (MOF) glass anodes as well as in the MOF glass/nano-silicon composite anodes [7,8,10]. We report the progress in developing glassy electrolytes for LIBs. We present some results concerning the recycling of spent LIBs for fabricating high-performance batteries. Finally, I highlight the challenges and prospects for the future application of glasses in both all-solid-state LIBs and NIBs. [1] J. Janek, W. G. Zeier, Nat. Energy 1 (2016) 16141. [2] M. H. Braga, N. S. Grundish, A. J. Murchison, J. B. Goodenough, Energy & Environmental Science 10 (2017) 331-336. [3] Y. F. Zhang, P. X. Wang, T. Zheng, D. M. Li, G. D. Li, Y. Z. Yue, Nano Energy 49 (2018) 596-602. [4] Y. F. Zhang, P. X. Wang, G. D. Li, J. H. Fan, C. W. Gao, Z. Y. Wang, Y. Z. Yue, Nano Energy 57 (2019) 592–599. [5] F. Y. Xiong, Q. Y. An, L. X. Xia, Y. Zhao, L. Q. Mai, H. Z. Tao, Y. Z. Yue, Nano Energy 57 (2019) 608-615. [6] Z. J. Jiang, T. Y. Zhao, J. J. Ren, Y. F. Zhang, Y. Z. Yue, Nano Energy 80 (2021) 105589. [7] C. W. Gao, Z. J. Jiang, S. B. Qi, P. X. Wang, L. R. Jensen, M. Johansen, C. K. Christensen, Y. F. Zhang, D. B. Ravnsbæk, Y. Z. Yue, Adv. Mater. 34 (2022) 2110048. [8] J. J. Yan, C. W. Gao, S. B. Qi, Z. J. Jiang, L. R. Jensen, H. B. Zhan, Y. F. Zhang, Y. Z. Yue, Nano Energy 103 (2022) 107779. [9] C. W. Gao, J. H. Zhang, C. M. He, Y. Q. Fu, T. Y. Zhou, X. Li, S. L. Kang, L. L. Tan, Q. Jiao, S. X. Dai, Y. Z. Yue, C. G. Lin, Adv. Energy Mater. 13 (2023) 2204386. [10] R. S. K. Madsen, A. Qiao, J. Sen, I. Hung, K. Z. Chen, Z. H. Gan, S. Sen, Y. Z. Yue, Science 367 (2020) 1473–1476.

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