IMCN

Secteur des Sciences et Technologies

Invitation à la soutenance publique de thèse de

Xuelian LIU

Master degree of Engineering

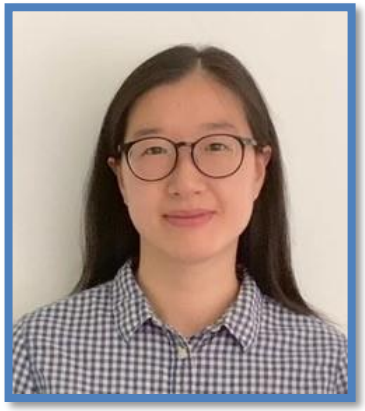
Pour l'obtention du grade de Docteur en sciences

« Inorganic Cathode Materials for Rechargeable Batteries from Lithium to Sodium Storage »

qui se déroulera
le jeudi 28 octobre 2021 à 13h
Auditoire MERC12
Place Louis Pasteur, 3
1348 Louvain-la-Neuve
et en visioconférence

Jury members :

Prof. Alexandru Vlad (UCLouvain), supervisor
Prof. Yann Garcia (UCLouvain), chairperson
Prof. Sophie Hermans (UCLouvain), secretary
Prof. Jean-François Gohy (UCLouvain)
Prof. Jun Chen (Nankai University, China)
Prof. Jilei Liu (Hunan University, China)
Prof. Bao-Lian Su (Université de Namur)



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Lithium-ion battery (LIB) as a powerful energy storage system is used to power many things from mobile phones to electric vehicles. The harvested green but intermittent solar and wind energy can also be stored in LIBs. While LIBs dominate the market, scarcity of Li resources has brought our community to concerns about the sustainable development of LIBs in the long run. Sodium-ion batteries (SIBs) as immediate and low-cost alternatives to LIBs have caught much researchers' attention. However, accommodation of large Na ions in host electrode materials could be difficult and thus development of high performance electrode materials especially cathode materials is essential for advancement of SIBs as a more practical energy storage system.

In this thesis, vanadium oxides were selected to systematically study the impacts of phase structures, carbon matrices and morphologies on electrochemical properties of cathode materials for Li and Na storage. Then, cathode materials in Fe-$PO_4$-F chemical space have been originally explored based on the concepts of stable polyanion framework, off-stoichiometry and metastability, aiming at development of advanced and sustainable cathode materials for SIBs. All the studied materials show electrochemical activity.

Particularly, metastable $Na_{1.2}Fe_{1.2}PO_4F_{0.6}$ material displays the best performance with energy density of nearly 400 Wh $kg^{-1}$ attained at the material level, with good reversibility and stability. Besides, activated iron-rich $Na_{0.6}Fe_{1.2}PO_4$ material was first found to show excellent long term cycling performance and rate capability and more than 350 Wh $kg^{-1}$ energy density can be attained at the material level.

Overall, Li storage and Na storage were compared in the case of $VO_x$@rGO cathode materials and, moreover, a promising new class of iron-based polyanionic cathode materials were explored for SIBs. This work could as guidelines for future investigation and development of new cathode materials.