The structural stability of lithium lanthanum zirconium oxide (LLZO) garnet in aqueous media has been unveiled by using the state-of-the-art scanning transmission electron microscopy. The use of aqueous catholyte in a high-energy lithium-air battery requires a lithium-stable solid electrolyte that can be used in a broad pH range. Although observed in experiments, the structural stability of LLZO in neutral and strong basic aqueous environments has not been confirmed at the atomic level. In this study, microscopic process of the interactions between LLZO and aqueous solutions has been elucidated through atomic level imaging methods. The reversible Li⁺/H⁺ exchange has been confirmed at particular crystallographic positions without affecting the cubic structure of LLZO. Thus the cubic LLZO is free from the severe protonation-induced conductivity degradation that occurred in other known garnets. Solid electrolytes for aqueous media are crucial for lithium-air batteries that have an energy density about 10 times higher than conventional Li-ion batteries. The present study benefits the development of multiple novel battery technologies beyond state-of-the-art Li-ion batteries.

Reference
“Excellent Stability of a Li-Ion-Conducting Solid Electrolyte upon Reversible Li⁺/H⁺ Exchange in Aqueous Solutions”
Cheng Ma,1 Ezhiylmurugan Rangasamy,1 Chengdu Liang,1 Jeffrey Sakamoto,2 Karren L. More,1 and Miaofang Chi1
1 Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, Oak Ridge, Tennessee.
2 Department of Chemical Engineering and Materials Science, Michigan State University, East Lansing, Michigan.

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