Press Release

Ohara LICGC™ PW-01 Powder increases the cycle life of lithium ion batteries by 4 times at high temperature

OHARA has developed and evaluated a Lithium Ion Conducting Glass Ceramic (LICGC™) powder, PW-01, that functions as a cathode additive in lithium ion batteries and enhances battery performance. This unique glass ceramic powder inhibits the growth of resistive layers in the electrode, increases the charge and discharge cycles by 4X, and greatly improves stored energy retention at high temperature.

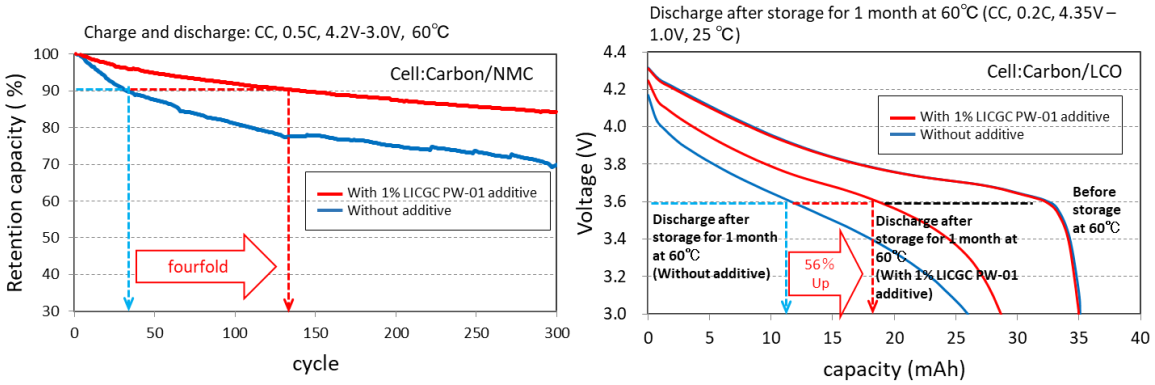
Through collaboration with Ritsumeikan University in Japan, Ohara clarified the mechanism by which LICGC™ PW-01 powder can significantly increase the lifetime and storage of lithium ion secondary batteries. When the PW-01 powder was used as an additive in the cathode it significantly reduced the progressive surface deterioration and resistive layer formation on the active material. The charge and discharge cycle numbers of the lithium ion battery containing LICGC™ PW-01 powder in the Lithium Nickel Manganese Cobalt Oxide (NMC) cathode increased by 4 times and battery retention capacity increased by 11% at 60℃, the point at which the retention capacity normally decreases by 10%.

The testing confirmed that when a small amount (1%) of the LICGC™ PW-01 powder was added to the cathode mixture of a lithium ion secondary battery the following performance enhancements were realized:

- Growth of resistive layers in the electrode were inhibited at high temperature
- Battery performance, in terms of charge and discharge cycle numbers, increased by 4X at 60℃ (Carbon/NMC cell)
- After storage for 1 month at 60℃, battery retention capacity was increased by 11% and discharge capacity increased by 56% at the discharge voltage of 3.6V (Carbon/LCO cell)

OHARA had previously found that adding LICGC™ PW-01 powder in the cathode had other significant effects, including increasing the battery capacity at high rate and at low temperature (-20℃). The LICGC™ PW-01 powder can serve an important role in improving the performance, life-time, and storage of batteries used in electric vehicles and other applications.

Evaluation results



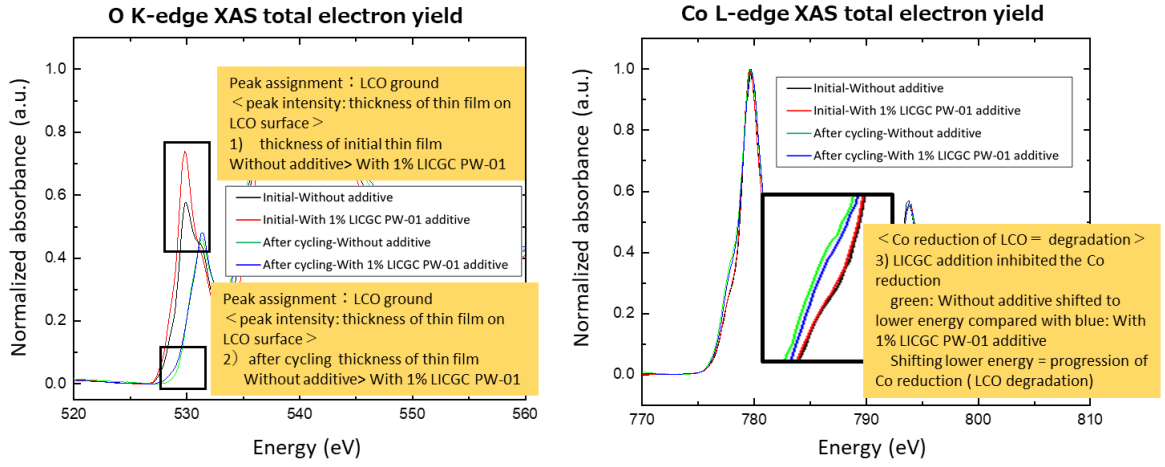
Through the collaboration with Ritsumeikan University, X-ray absorption spectroscopy (XAS) was used to evaluate the surface state of the active material in the cathode over the increasing number of charge and discharge cycles. The results indicate that adding 1% LICGC™ PW-01 powder in the cathode inhibits the growth of the resistive layers.

1) XAS (Ritsumeikan Univ.) confirmed the resistive layer generated on the cathode (LCO) with 1% of LICGC™ PW-01 powder was thinner than the layer without LICGC™ PW-01 powder at the initial charge and discharge at 25℃.

2) We confirmed the resistive layer generated on the cathode (LCO) with 1% of LICGC™ PW-01 powder was thinner than the layer without LICGC™ PW-01 powder after 500 charge and discharge cycles at 60℃.

3) We confirmed the progressive reduction on the surface of the cathode (LCO) with 1% LICGC™ PW-01 powder was inhibited more than the layer without LICGC™ PW-01 powder after 500 charge and discharge cycles at 60℃.

[The sample for XAS was made by OHARA. (Initial charge 4.35V CV-CC 0.05A, 0.1C discharge to 3.0V at 25℃, after 1C charge and discharge 4.35-3.0V at 60℃)]



The XAS results at Ritsumeikan University SR center were analyzed in collaboration with Ritsumeikan University and OHARA.

After reviewing the XAS measurements, OHARA identified the mechanism by which including the LICGC™ PW-01 powder in the LCO cathode inhibits the deterioration of the surface of the active material, resulting in longer life of the lithium ion battery at high temperature. As is well known in the industry, hydrofluoric acid (HF), which is generated through the chemical reaction caused by infinitesimal water (H_2O) and electrolyte salt ($LiPF_6$) in the non-aqueous liquid electrolyte, deteriorates the surface of the active material in the cathode and degrades lithium ion battery performance[1,2]. We clarified that LICGC™ PW-01 powder when used as a cathode additive inhibits HF generation, thus reducing the formation of thin surface resistance layers and reduction layers on the cathode active material.

OHARA's results indicate that cathodes containing Lithium Ion Conducting Glass Ceramic (LICGC™) PW-01 powder enhance the high temperature discharge cycles of lithium ion batteries by controlling the degradation of the active material in the cathode. The LICGC™ glass ceramic electrolyte powder can significantly improve battery retention capacity and life at high temperature.

Reference: 1. Electrochimica Acta 277(2018)59-66
2. Angew. Chem. Int. Ed. 2012, 51, 11597–11601

[LICGC™ feature]

OHARA began development of lithium ion conductive glass ceramics [LICGC™] in 1995. These oxide based glass ceramics have high lithium ion conductivity and are typically used as solid electrolytes. LICGC™ is stable in air and water, and can be used with organic solutions. LICGC™ is used as solid electrolytes or membranes in next generation batteries, lithium air cells, all solid state batteries and lithium purification / collection equipment.

[Company profile]

OHARA has been a leading supplier of high quality optical glass and special materials to the camera and optics industries since our establishment in 1935.

OHARA has developed various types of glass ceramics materials including "NANOCERAM™", which has excellent impact strength and hardness characteristics and "CLEARCERAM™-Z" , an ultra-low expansion glass ceramic utilizing nano size grain structure.

[Company outline]

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