PSW13B : 첨단세라믹 인력양성

PSW13B-1 | Stabilizing Li_2O-based Cathode/Electrolyte Interfaces through Succinonitrile Addition

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Li_2O-based cathodes utilizing oxide–peroxide conversion are innovative next-generation cathodes that have the potential to surpass the capacity of current commercial cathodes. However, these cathodes are exposed to severe cathode–electrolyte side reactions owing to the formation of highly reactive superoxides (O^{x-}, $1 \leq x < 2$) from O2- ions in the Li_2O structure during charging. Succinonitrile (SN) has been used as a stabilizer at the cathode/electrolyte interface to mitigate cathode–electrolyte side reactions. SN forms a protective layer through decomposition during cycling, potentially reducing unwanted side reactions at the interface. In this study, a composite of Li_2O and Ni-embedded reduced graphene oxide (LNGO) was used as the Li_2O-based cathode. The addition of SN effectively thinned the interfacial layer formed during cycling. The presence of a N-derived layer resulting from the decomposition of SN was observed after cycling, potentially suppressing the formation of undesirable reaction products and the growth of the interfacial layer. The cell with the SN additive exhibited an enhanced electrochemical performance, including increased usable capacity and improved cyclic performance. The results confirm that incorporating the SN additive effectively stabilizes the cathode–electrolyte interface in Li_2O-based cathodes.

PSW13B-2 | Investigating the crystal fields of aluminate phosphors to understand a diverse spectrum of emission wavelengths from red to SWIR

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The introduction of activators into the host material of the phosphor can result in a range of emission spectrum characteristics. This variety is not solely determined by the inherent energy levels of the parent or activator material, but also by the crystalline structure that forms within the phosphor. In this study, we report multi-component aluminate phosphor that synthesized by solid-state reaction method. This phosphor has five different doping sites, comprising three octahedral and two tetrahedral sites, each with a different crystal field that results in varying emission wavelength. Two excitation peaks centered at 410 nm and 570 nm were observed. The aluminate phosphor displayed two different emission regions: one from 610 to 1050 nm, and the other from 1350 to1800 nm. Each region exhibits two types of peaks: two sharp emission peaks with centered at 610 and 1390 nm, and two broad emission peaks centered at 890 and 1550 nm. As the amount of activator increases, the intensity of sharp peaks decreases while that of the intensity of broad peaks increases. This behavior is caused by the different crystal fields of the activator sites. The variety of doping sites within this phosphor allows for the evaluation of the effect of crystal field on emission. We also fabricated a prototype of SWIR light LED was fabricated by coating aluminate phosphor on a violet LED chip.

PSW13B-3 | Synthesis and Evaluation of reusable core-shell abrasive (Fe3O4@SiO2) as CMP slurry utilizing their superparamagnetic property

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CMP slurry is used to polish the surfaces of semiconductors, primarily employing silica (SiO2) slurry for thin film layer polishing, such as tungsten and copper. In this study, we aim to introduce a method for recovering and recycling nanoparticles (NPs) using the magnetic properties of superparamagnetic Fe3O4 cores. The waste slurry generated from such polishing processes in semiconductor manufacturing is difficult to recycle, and most of it is incinerated or landfilled, leading to the risk of environmental pollution. The Fe3O4 composing the core controls the particles, and the silica forming the shell plays a role in polishing the semiconductor. To enhance W CMP performance and facilitate the recycling of waste slurry, we synthesized superparamagnetic core-shell Fe3O4@SiO2 nanoparticles using a sol-gel-based Stöber process. Subsequently, we conducted an analysis of the polishing performance and recovery efficiency.

PSW13B-4 | Enhanced oxygen evolution reaction of Nickel@Iron core-shell nanostructure decorated on multi-wall carbon nanotubes via pulsed laser ablation in liquid media

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Noble metal-based electrocatalysts, such as RuO_2 and IrO_2, have been employed for the oxygen evolution reaction (OER) in alkaline water splitting. However, their widespread industrial application is hindered by high

costs and limited availability. In this study, we report transition metal-based oxides supported on carbon nanotubes (CNTs) as an efficient electrocatalyst for OER. Experimental results show that amorphous/crystalline oxides anchored on CNTs provide a substantial enhancement in OER performance. Optimized electrocatalysts demonstrate excellent OER activity, with an overpotential of only 286 mV at a current density of 10 mA/cm^2 and a Tafel slope of 32 mV/decade. This work provides clear evidence that the formation of amorphous/crystalline heterostructure on conductive supports is beneficial for further enhancing the OER performance in alkaline water splitting.