Core-shell Alginate Microgels with an Electro-Responsive Movement

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Alginate is the kind of polysaccharide derived from seaweeds and having negatively-charged polymer chain, aqueous solution forms microgels under the presence of multiply-charged metal ions, e.g. Ca^{2+} or Mg^{2+} due to forming ion cross-linking points. On the other hand, microgels are transparent and their absolute zeta potential $|\zeta|$ changed by exchange reactions. Modifying surface of microgels to get high absolute zeta potential $|\zeta|$ and electrophoretic mobility of microgels is simpler than some reported methods. Recently, Ti or TiO_2 power has studied for the application of electronic paper material, because its excellent darkness or whiteness and high refractivity display good image contrast in suitable suspension media. Moreover, surface properties of Ti or TiO_2 power lead not only high electrostatic repulsion but also repulsion due to absorbed polymer layers, as known steric repulsion. However, Ti or TiO_2 power has low dispersion stability and sedimentation state in aqueous media. Thereby, alginate/Ti or TiO_2 composite microgels with modified alginate/Ti or TiO_2 composite microgels surface in order to enhance the mobility and dispersion stability of electrophoretic microgels have improved drawbacks of Ti or TiO_2 power and alginate hydrogel for electronic paper application. The position controlling of these independent microgels have not been realized since gel nano/micro particles are usually used in liquid and they are highly dispersed in it. Therefore, we have proposed that position of these alginate/Ti or TiO_2 composite microgels could be controllable by the electric field after increasing their surface absolute zeta potential $|\zeta|$. To increase their surface absolute zeta potential $|\zeta|$, we have examined surface modification of alginate/Ti or TiO_2 composite microgels by immersing them into Na_2CO_3 with HCl aqueous solution in a few seconds. After this chemical modification, we have confirmed that the electrophoretic mobility of alginate/Ti or TiO_2 composite microgels in pure water were from $-0.09\times10^{-4}cm^2/Vs$ to $-5.06\times10^{-4}cm^2/Vs$, and theirs absolute zeta potential $|\zeta|$ were increased from 1.3mV to 73mV, electroresponsive behavior of alginate/Ti or TiO_2 composite particles was drastically improved. We believe that our results should significantly affect to surface and colloid science as well as electric paper industries.

***Keywords**:* calcium alginate hydrogel, e-paper, zeta potential, electrophoretic mobility