SEARCH AND CHARACTERISATION OF BINDERS FOR AQUEOUS SODIUM ION BATTERIES

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Binders play a crucial role in rechargeable batteries by preserving the structure of electrodes. Binders are usually used in small amounts, because they do not participate in electrodes electrochemical reactions, but despite the small amount in the overall electrode composition binders have a significant impact on battery performance. In order to ensure a reliable electrode performance customization of binders is crucial. The most commonly used binder is poly(vinylidene) difluoride due to its chemical and electrochemical stability, mechanical strength. However, it displays poor adhesion to electrode components, especially when it comes to emerging high-capacity active materials, PVDF is an electrical insulator, meaning, that electrodes need additional additives to function properly. Also in order to use PVDF a toxic and rather expensive solvent N-Methyl-2-pyrrolidone is needed, which has a high boiling point, which leads to more energy wasted during the evaporation of solvent. This research focuses on finding greener and cheaper alternatives for PVDF in aqueous sodium ion batteries. The aim of this study was to create anodes, using commercially available cheap polymers and sodium titanium phosphate in order to study the polymer stability and behavior in aqueous sodium ion batteries. Properties of the anodes were investigated by cyclic voltammetry and galvanostatic cycling. The selected commercial polymers were Polyvinyl Butyral 30, Laropal A 81, Paraloid B67, Plexigum PQ611, Paraloid B48N, Paraloid B82, Paraloid B44 and Regalite R1125. The selected materials were tested in order to see if they could be applicable as binders for anodes. Out of the 8 polymers PVBA showed the best results due to its high viscosity, high initial capacity and capacity fade comparable to PVDF. Also the methacrylate based binders showed good electrochemical stability and electrodes made with them were comparable to PVDF containing ones. The main shortcoming of these electrodes is minor cracking, which could be mitigated by using different solvents and polymer concentrations. The worst preforming binders were aldehyde and hydrocarbon based. They were difficult to work with, showed bad electrochemical activity and no mechanicalsuture they will not be further investigated.

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