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Carbon-Based Magnetron Sputtered Films on Aluminium Foil as Functionalised Current Collector for Lithium Ion Cells and Capacitors

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Low costs, a low specific weight and a peculiar electrochemical stability qualify aluminium foil (Al-foil) as current collector in Lithium Ion Cells and Double Layer Capacitors. In case of the usage of untreated Al-foil in electrochemical cells the dielectric character of 3-4 nm, native alumina films (that cover Al- surfaces) cause intolerable electrical resistances and lead to a poor cycling behaviour. Chemical treatments e. g. surface etching along with the application of 'conductive primer coatings' is state-of-the art. Typical coatings are solvent-based dispersions of graphite in a thermoset binder. The coating process is complex, expensive and thus achievable functional layers exhibit a considerable thickness of some microns. These aspects mainly motivate the approach to use PVD and transfer this technology to battery production. Our presentation highlights morphological and electrical properties of magnetron sputtered carbon films on a sputtered Al-underlayer and sputtered carbon-aluminium cermets, respectively. The two component systems possess a thickness less than 100 nm and were deposited on aluminium foil. A DC powered magnetron head was used to sputter Al, a second RF head was equipped with a graphite target. Results from AFM, STM/STS and 4-point measurements will be presented. The investigations prove that film conductivity can be modified and scales with the thickness of the sputter layers and the Al/C-ratio. A comparative study on the cycling behaviour of tests cells has been undertaken, too. Good cycling stability could be verified for test cells that yielded a sputter coating on the cathode's Al-collector. PVD seems to be a very promising technique in order to functionalise current collectors for specific batteries and capacitors.

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