Surface fluorination of MCMB and conductive agent by reactive gas in atmospheric pressure plasma and their applications

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Fluorine treatment by atmospheric pressure plasma has been applied on the surface of an anode active material Meso Carbon Micro Beads (MCMB) and an electro-conductive agent powder (super P carbon black) used in lithium-ion batteries. It was confirmed that the treated super P powder has low the irreversible capacity loss during the initial charge-discharge formation process. A DBD electrode system was used for plasma fluorination process that is a chemical reaction between the carbon powder and the dry gas which contains plasma activated fluorine species under atmospheric pressure at room temperature. Activated fluorine species including HF generated by N_2 /NF_3/H_2 mixed gas plasma were observed by the QMS and FT-IR gas analyzer. XPS data shows that the C- F bond was formed only on basal surface of the fluorine-treated super P, while in the case of the MCMB, some C- F bonds on edge were also shown besides on its basal surface. The electrical resistance of the treated carbon powder slightly was increased by less than 1 ohm, but we expect to improve the adhesion with binder and suppression of other side reactions e.g. protection from penetration of moisture, electrolyte etc. So, this treatment technique employing fluorine discharge gas could be a promising method to enhance charge/discharge cycle characteristics and performance of LIB.

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