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FLUORINE INTERCALATED GRAPHITES AND BATTERY APPLICATIONS

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A battery based on the fluorine-lithium system gives the highest theoretical energy density for both equivalent weight and volume because of the maximum electronegativity diference between the cell reactant. This possibility has been realized by the use of graphite fluoride, $(C_xF)_n$ as a cathode material for lithium battery in nonaqueous electrolyte systems. Detailed investigations on electrochemical characterisitics and discharge reaction mechanism of the batteries have shown that structural properties of a host material graphite has important influences on fluorination reaction and physical properties of resulting compounds, particularly electrochemical behaviours. Accordingly, novel fluorine intercalated graphites, $(C_xF)_n$ have been prepared by the reaction of elemental fluorine with recently developed new forms of carbons; vapour grown carbon fibers from benzene-derived precursor materials, activated carbon fibers derived from rayon and mesophase carbons. An attractive feature of these as a host material is that they can easily take up fluorine at a fairly low temperature range of 20-380°C within very short reaction times. The nature of C-F bonds vary from chemisorption through charge transfer to covalent bond with rising reaction temperature, which is reflected in the strong colors from black through brown, yellow and white.

Electrochemical characteristics of the cells based on $(C_xF)_n$/Li in a nonaqueous electrolyte are associated with stoichiometry, structure and nature of C-F bond. Fluorine atoms fixed in carbon matrix at lower temperatures have higher activities and OCV's are a function of the formation temperature; decrease with increasing temperature from ca. 3.8 to 3.2 V. The discharge characteristics strongly depend on structural features of $(C_xF)_n$; the size and ordering of crstallites, and the amount of defects play important role for potential and stability of discharge, and cathode utility. A certain three dimensional structure of $(C_xF)_n$ is required to be able to discharge.

Solid state batteries based on graphite intercalation compounds, $(C_xF)_n$, $C_x(SbF_6^-)_y(SbF_5)_{1-y}$/solide electrolyte, poly(ethylene oxide)-$LiClO_4$ or $PbSnF_4$ are also shown.