Electrochemical properties of stable organic radicals for rechargeable Na ion battery

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According to the rapid spread of the HV, Plug-in HV, EV, low cost, high power and high capacity rechargeable batteries are required. To meet these demands, Na ion secondary batteries were focused recently because of the infinite Na sources and wide selectivity of the active materials.

Organic chemistry plays an important role in the development of high-performance rechargeable batteries. The use of nitroxide radical polymers as active cathode materials affords good cycle performances and output voltages (3.6 V) that are two-thirds those of Li-ion batteries (150–170 Ah/kg).[1-3] The use of conjugated carbonyl compounds as active electrode materials is a promising technology for overcoming the safety and environmental issues inherent to the use of $LiCoO_2$.[4-6]

Recently, it was reported high-capacity rechargeable batteries that make use of stable neutral radicals, that is, 6-oxophenalenoxyl (6OPO)[7,8,9] and trioxotriangulene derivatives (R_3TOT, R = *t*-Bu, Br)[10] (Fig. 1) as active cathode materials for Li ion batteries. R_3TOT can undergo a four stage redox process because of two degenerate lowest unoccupied molecular orbitals (LUMOs) with energy levels close to a singly occupied molecular orbital (SOMO).[9] Li ion battery based on (*t*-Bu)$_3$TOT showed a capacity as high as 311 Ah/kg in the first discharge process.[10]

It is well known quite a few organic materials for Na ion cell have been reported so far. It has been reported that the metal-organic frameworks: MOFs[11] were reported as the organic type anode materials for Na ion batteries.[5,12-14] In this work, we investigate the electrochemical properties of the stable organic radicals: TOT derivatives for Na ion battery.

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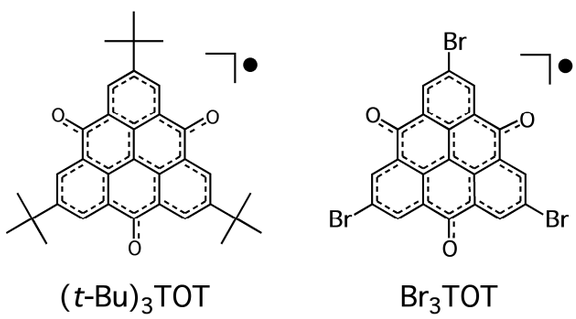

Fig.1 Chemical structure of trioxotriangulene derivatives (R_3TOT, R = *t*-Bu, Br)