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SYNTHESIS AND CHARACTERIZATION OF Li_2FeSiO_4/C COMPOSITE

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Polyoxyanion compounds, particularly the olivine phosphate $LiFePO_4$, are receiving considerable attention as cathodes for rechargeable lithium batteries. Despite its numerous advantages, olivine phosphate severely suffers from poor rate performance due to its inherent conducting properties and limited capacity. More recently, an entirely new class of polyoxyanion cathodes based on the orthosilicates (Li_2MSiO_4, M = Fe, Mn, and Co), has been attracting growing interest. Li_2MSiO_4 has two lithium ions per formula unit, suggesting a higher theoretical capacity than phosphate. Lithium iron orthosilicate, Li_2FeSiO_4, is very important member of orthosilicates family due to its electrochemical stability, cell safety, eco-friendliness, and cost effectiveness. It is proposed as another promising alternative cathode material for the same lattice stabilization effect as in $LiFePO_4$ through the presence of strong Si–O bond. The lower electronegativity of Si vs. P would result in a lowering of the $Fe^{2+}\leftrightarrow Fe^{3+}$ couple and therefore Li_2FeSiO_4 often possesses a lower electronic band gap and higher electronic conductivity in comparison with $LiFePO_4$. Although Li_2FeSiO_4 is known for several years, it is still a challenge obtaining a phase pure material with desired particle size and good electrochemical characteristics. Here we report citric acid assisted sol-gel method for Li_2FeSiO_4/C composite synthesis. Starting compounds were $LiNO_3$, $Fe(NO_3)_3$ and $Si(OC_2H_5)_4$ (tetraethyl orthosilicate, abbrev. TEOS). Citric acid was used as a chelating agent. Sol-gel preparation of Li_2FeSiO_4/C powder was conducted via two routes: (i) one starting from water solutions of above mentioned compounds and (ii) other starting from ethanol solutions of the same compounds. Synthesis in alcohol solution proved to be much faster due to fast hydrolysis of TEOS in presence of alcohol and rapid gel formation. Final product obtained from alcohol solution contains a higher percentage of carbon.