The low-temperature chemical synthesis of $Li_4Ti_5O_{12}$ powder for Li-ion battery anodes

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While using $Li_4Ti_5O_{12}$ (LTO) as the anode material in lithium ion batteries greatly enhances their operation safety and avoids the formation of a solid electrolyte interface, the synthesis of this material often comes at a high time and energy cost. A typical solid-state synthesis method requires the reagents to be kept at temperatures up to 900 °C for several hours. Both synthesis temperature and processing time were reduced by applying the concept of solution combustion synthesis. In this method, a sol-gel precursor is synthesized which generates the energy needed for complete sample conversion and crystallization in an exothermic reaction. A large number of parameters inherent to this concept were studied. The physical properties of both precursor gels and thermally processed powders were characterized by thermogravimetric analysis (TGA) coupled with differential scanning calorimetry (DSC), Fourier transform infrared spectroscopy (FT-IR) and mass spectrometry (MS), Raman spectroscopy and X-ray diffraction (XRD). By using the concept of solution combustion synthesis, the synthesis temperature and time were significantly reduced. The oxidizer amount is of great importance. Solution combustion synthesis can considerably lower the temperature and time required for the synthesis of ceramic materials, but careful optimization of the precursor gel is necessary, since the mechanism of thermal degradation is complex and dependent on a large number of parameters.