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氢氧焰燃烧合成核壳结构纳米 TiO_2/SiO_2复合颗粒及机理分析

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摘要 利用多重射流氢氧焰燃烧反应器, 通过控制进料方式, 以$TiCl_4$和$SiCl_4$为原料合成了具有典型核壳结构的纳米TiO_2/SiO_2复合颗粒, 并分析了氢氧焰燃烧合成过程中核壳结构的形成机理. 在纳米TiO_2/SiO_2复合颗粒中, 无定形的SiO_2均匀地包覆在晶态TiO_2颗粒表面形成核壳结构, 引入SiO_2不但有效抑制TiO_2晶粒的生长, 而且抑制了锐钛相向金红石相的转变. 在$TiCl_4$和$SiCl_4$次序进料时, $TiCl_4$优先反应并通过成核生长生成TiO_2纳米颗粒, $SiCl_4$反应生成的SiO_2通过在TiO_2颗粒表面非均相成核生长, 形成核壳结构的纳米复合颗粒.

关键词 氢氧焰 气相燃烧 核壳结构 TiO2 SiO2

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Mechanism Analysis and Preparation of Core-shell TiO_2/SiO_2 Nanoparticles by H_2/Air Flame Combustions

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Abstract Core-shell TiO_2/SiO_2 nanoparticles were synthesized successfully by H_2/Air flame combustions, and the formation mechanism of core-shell nanoparticles was analyzed. The structures and properties of these TiO_2/SiO_2 particles were investigated by using TEM, HRTEM, XRD and FTIR. The transformation from anatase to rutile and the grain growth are hindered due to the addition of silica into matrix. Both the chemical reaction rate and the nucleation rate of TiO_2 particles are much faster than those of SiO_2. The formation of primary TiO_2 particles is faster than that of SiO_2 in the third jet due to the low temperature and nuclear rate. Heterogeneous nucleaton of SiO_2 on the surface of TiO_2 is the main reason of core-shell nanocomposites formation.

Key words H2/air flame flame combustions core-shell TiO2 SiO2

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