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胶溶-水热晶化过程中纳米TiO_2晶粒聚集机理及形貌的研究

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摘要 通过XRD、SEM和动态光散射粒度测定仪(DLS)研究了胶溶及水热晶化过程中纳米TiO_2晶粒聚集行为及形貌. 实验结果表明, 在胶溶无定形沉淀过程中所形成的大小为10~15nm的锐钛矿(A)型胶粒或金红石(R)型胶粒(初级粒子)易定向聚集成更大的、具有(30~50)nm×(80~100)nm的次级晶粒. 含有次级晶粒的溶胶前驱液在水热晶化过程中, 次级晶粒发生崩裂并生长成结晶度更高的大小约为10~30nm球形(A型)和大小约为20~60nm棒状(R型)纳米TiO_2.

关键词 二氧化钛 聚集结晶 胶溶 水热晶化

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Aggregation Behavior and the Resulting Morphology of Nanocrystalline Titania in Peptization and Hydrothermal Process

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Abstract During the process of peptization and hydrothermal crystallization, the aggregation behavior and the resulting morphology of nanocrystalline titania (TiO_2) were studied by X-ray diffraction (XRD), scanning electron microscope (SEM), and dynamic light scattering (DLS) techniques. The results show that during peptization process the mixture of rutile-type and anatase-type primary particles with 10--15nm in diameter formed by peptizing the precipitated amorphous titania are transformed into rod-like secondary crystalline grains with sizes of (30--50)nm×(80--100)nm through an oriented aggregation mechanism, which obey a crystal face-matching rule. In the process of hydrothermal crystallization under 180℃, however, the rod-like secondary crystalline grains are first broken into nanoparticles with diameter in the range of 10--15nm (namely the same sizes as those of the primary particles), and the formed nanoparticles then grow in hydrothermal solution. The finally resulting particles with the sizes of 10--30nm (spherical anatase) and 20--60nm (rod-like rutile) are found to have a higher crystallization degree than the primary particles formed in the process of peptization.

Key words titania aggregation crystallization peptization hydrothermal crystallization

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