Effect of sintering temperature and porosity on electro-deoxidation of calcium titanate in $\text{CaCl}_2\text{-NaCl}$ molten salt

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Received: 5 November 2021 / Accepted: 17 December 2021 / Published: 5 January 2022

The performance of cathodes has an important influence on the degree of deoxidation when preparing titanium via a molten salt electro-deoxidation process. In this study, CaTiO_3 was used as a cathode to investigate the influence of sintering temperature on the degree of electro-deoxidation. The results show that increasing the sintering temperature from 900 °C to 1200 °C can effectively improve the conductivity of a CaTiO_3 cathode, which is conducive to electron migration. However, a high temperature (1300°C) leads to excessive grain growth, increasing the solid phase transport distance for O^{2-} , which is not conducive to deep reduction of the cathode. When sintered at 1200°C, the CaTiO_3 cathode shows the most in-depth deoxidation, which is suitable for electro-deoxidation of the precursor to prepare titanium. In addition, the effect of porosity on the degree of deoxidation was also studied. When the NH_4HCO_3 content increases from 2% to 10%, the porosity is increased, which leads to a decrease in the mechanical strength of the cathode, and a part of the cathode becomes detached from the matrix during the electrolysis process, leading to failure of the reduction reaction. Moreover, a considerable amount of unreacted CaTiO_3 is present in the cathode product with 10 wt.% NH_4HCO_3 because the cathode with high porosity produces cracks in the electrolytic process. By comparing the deoxidation effect before and after adding 2% NH_4HCO_3 under optimal conditions, CaTiO_3 cathodes sintered at 1200°C without NH_4HCO_3 were found to be thoroughly electrolysed, with the purity of the titanium obtained reaching 97.65%.

Keywords: Molten salt electro-deoxidation, sintering temperature, porosity, titanium.

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