Low Temperature Electrochemical Synthesis of Nanostructured ZrC Powder in Molten Salt

Hongxia Liu^{1,*}, Weihao Song¹, Qian Xu^{2,*}, Wen Ma¹, Yu Bai¹

¹ School of Materials Science and Engineering, Inner Mongolia University of Technology, Inner Mongolia Key Laboratory of Thin Film and Coatings, Hohhot 010051, Inner Mongolia, PR China

² State Key Laboratory of Advanced Special Steel, Shanghai University, Shanghai 200072, PR China.

*E-mail: pghx@163.com, qianxu@shu.edu.cn

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ZrC powder was directly electrosynthesized from inexpensive ZrO₂ and carbon black precursors in molten CaCl₂-NaCl at 800 °C. Constant voltage electrolysis was applied at 3.1 V between a graphite anode and a cathode composed of a ZrO₂/carbon mixture. The reaction pathway of the solid state reduction was investigated by characterizing the composition and microstructure of partially and fully reduced samples. The spontaneous formation of the intermediate compound CaZrO₃ was studied by an immersion experiment and thermodynamic analysis. The results show that the as-synthesized ZrC was composed of spherical particles with an average particle size of roughly 50 nm. The reduction pathway started by converting m-ZrO₂ to CaZrO₃, ZrC_xO_{1-x} and t,c-ZrO₂. The phases of t,c-ZrO₂ and CaZrO₃ were then reduced to ZrC_xO_{1-x}, which was subsequently reduced to ZrC by the removal of oxygen and in situ carbonization.

Keywords: ZrC; electrochemical; ZrO₂; molten salt

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