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Thermal Behaviour of Cermets and Hardmetals during Debinding and Sintering

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Abstract

Most important processes during heat treatment of powder mixtures for production of cermets and hardmetals are drying, dewaxing, outgassing, melting of the binder phase and sintering. Results of sintering experiments on the lab scale are presented and discussed. The experiments include sintering of materials with various compositions of hard phases (WC, TiCN) and metallic binder phases (Co, Ni).

The multiphase reactions are investigated by methods of thermal analysis (Thermodilatometry, Differential Thermal Analysis, Thermogravimetry). Selected microstructures are inspected by high resolution field emission scanning electron microscopy. The influence of furnace atmosphere (cermets in helium or nitrogen and hardmetals in helium) and gas pressure on gas reactions are investigated by a thermobalance-mass spectrometer-system. For these studies an orifice coupling system for normal pressure in the thermobalance (1000 mbar) was modified in order to use this system also at a pressure range of approximately 0.1 to 10 mbar.

The achieved process knowledge enables better understanding for sintering cermets and hardmetals and to improve both the processes and the material quality.

Keywords

sintering, gas reaction, thermal analysis, mass spectrometry, hardmetal, cermet

1. Introduction

Hardmetals or cemented carbides are powder metallurgical products composed mainly of WC and Co. Applications for such materials include cutting tools and wear resistant parts. Hard phases of cermets are TiC or Ti(C,N). The binder phase consists of Co and Ni. Cermets exhibit good high temperature, chemical and oxidation resistance but their mechanical properties are mostly inferior to WC based hardmetals [1]. Optimisation of sintering of hardmetals and cermets requires an understanding of complex changes in the solid, liquid and gas phase chemistries. In situ information is obtained during sintering of powder metallurgical products on the lab scale by thermal analysis [2]. Mass spectrometry is used to monitor changes in the gas composition as a function of temperature and time during heating

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