생체재료용 다공질 Ta 제조 및 소결특성
Synthesis of porous Ta and its sintering properties for biomaterial use

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1. Introduction

At present tantalum have found wide application in electronics, chemical and mechanical engineering, nuclear power and metallurgy due to the unique properties such as plasticity, durability, corrosion-stability, refractoriness, high coefficient of heat transfer and small work function of electrons. In particular electrical capacitors for a semi-conductor devices, heaters for a high-temperature furnaces, heat exchanger for a nuclear power systems have been produced from pure tantalum powder. In biotechnology metallic tantalum has also been applied to the fastening of bones and imposing of the seams, etc. Now a days the porous tantalum for biotechnology has been manufacturing by CVD process which is relative expensive method. In this study, porous tantalum powder was prepared by SHS process and sintering characteristics of the prepared tantalum powder was evaluated for the biomaterials.

2. Experimental

The combustion of reaction mixtures was carried out in a constant pressure reactor in argon atmosphere at the pressure of 0.5 MPa. Preliminary the initial mixture was stamped into the cylindrical metallic mould from stainless steel with the 2 mm thickness, 30mm diameter and 40mm in height. Experimental density of samples were 1.9-2.1 g/cm^3. The raw materials used in this study were: tantalum oxide-Ta_2O_5 (99.9 % purity, High Purity Chemicals Researches Center, Co. LTD, Japan) magnesium powder (98.5 % purity, Daejung Chemicals and Metals Co. LTD, Korea), sodium chloride (99.5 % purity, Samchun Pure Chemical, Co.LTD, Korea) and argon gas (99.9 % purity). During a typical experiment the pellet is placed into the reactor and the reaction is initiated by means of a nickel-chromium wire connected to the power supply, which was programmed to produce an energy pulse by setting 15-20 V for about 1.0-1.5.

3. Discussion and conclusion

The basic laws of combustion of Ta_2O_5-5Mg-kMgO and Ta_2O_5-5Mg-kNaCl systems are investigated, at k=0-5. The laws of change Tc and Uc are received. It is shown, that using MgO and NaCl as inert diluent decrease combustion temperature and mass lost during the combustion, thus provides completeness of interaction. It is shown, that in the both cases the chemical reaction starts from the melting temperature of magnesium. At that, depending on quantity of diluent two modes of combustion reaction are realized: $T_c > T_{melt.}$ Ta_2O_5, and $T_c < T_{melt.}$ Ta_2O_5. It is shown the advantage of NaCl use as an inert diluent. In particular it is established, that the use of NaCl promotes the formation of uniform and porous tantalum powders by size 100-200 nm and 99.9 wt. % purity.