2-COMPONENT-MIM PARTS WITH A FUNCTIONAL GRADIENT IN POROSITY

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ABSTRACT

2-component-MIM is a novel and innovative PM process. It offers the possibility to manufacture near-net-shaped PM parts combining different materials or materials properties. In the present study, the potential of the method was demonstrated on parts characterised by a functional gradient in porosity. Titanium parts with well defined porosities and pore sizes in the range of 355-500 µm were realised by use of suitable space holder materials. An important aim of this study was the development of suitable feedstocks, taking the large difference in particle sizes of metal powder and space holder into account. The feedstock rheology was characterised by capillary rheometry to investigate the influence of space holder on flowing behaviour. After removal of binder and space holder, the parts were sintered. A promising application of this method is the production of biomedical implants with a gradient in porosity.

INTRODUCTION

In the plastics industry, combination of materials often enables optimal properties of the finished part. The technologies involved require specially constructed injection moulding machines, in which at least two injection units are used. The process has been generally named 2-Component-Injection Moulding " or „Co-Injection Moulding"[1], and essentially consists in the injection of one component after the other, in which part of the mould is moved or turned after the injection of the first component. A variation of the method is the „Sandwich-Injection-Moulding". By this method, the first mass is injected in the mould cavity by the horizontal injection unit, so that an outer skin is formed. Immediately afterwards the core of the part is formed by the injection of the second mass by the vertical injection unit. Both masses are hereby injected through a common valve, which controls the separation of both materials.
The transfer of the "2-Component Injection Moulding" technology to powder metallurgy has attracted much interest in the last years. Parts combining different materials have been realised by Powder Injection Molunding (PIM) [2-7]. When metals powders are used, the process has been often named 2-Component-Metal Injection Molding (2-C-MIM).
Near-net-shape production of highly porous NiTi components by MIM in combination with the space holder method (SHM) was described previously [8]. By this technique, the metal powder together with the space holder and the binder are homogeneised in a kneader. The green parts are injection moulded and the space holder is removed after the first stage of debinding. The parts are then thermally debinded and sintered. The SHM guarantees a well defined pore size distribution with total porosities up to 70%. Different pore sizes and shapes in the range of 100-500 µm (0.004-0.020 in) can be achieved with NaCl as space holder. NaCl has proved to show a sufficient thermal and mechanical stability for injection moulding processing.