Powder injection molding of metallic lightweight micro-optics

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Abstract

A large number of different manufacturing processes have been established for the industrial production of optics. In addition to forming and shaping processes for the manufacturing of high-precision glass optics, ultra-precision turning, ultra-precision grinding, lapping and polishing are used for the production of metal based optics. However, the production of optics using ultra-precision machining processes is limited to the production of individual components, as the processes used involve a high level of manual set-up effort. In addition to a considerable demand for high-precision manufacturing processes with reduced manual effort, technologies for the manufacture of lightweight optics for aerospace applications are a major topic of current research. The approach presented for the application of metal injection moulding processes (MIM) for the series production of optical components can solve both problems. The MIM process enables the process-reliable production of high-precision optical components and is suitable for the production of weight-optimized optics due to the possibility of processing aluminum and magnesium. The influence of different feedstocks as well as debinding and sintering processes on shape accuracy and surface quality of refractive and diffractive optics was investigated. In order to optimize the injection molding process, parameter studies were carried out to produce components with a shape deviation and surface quality suitable for optical applications.