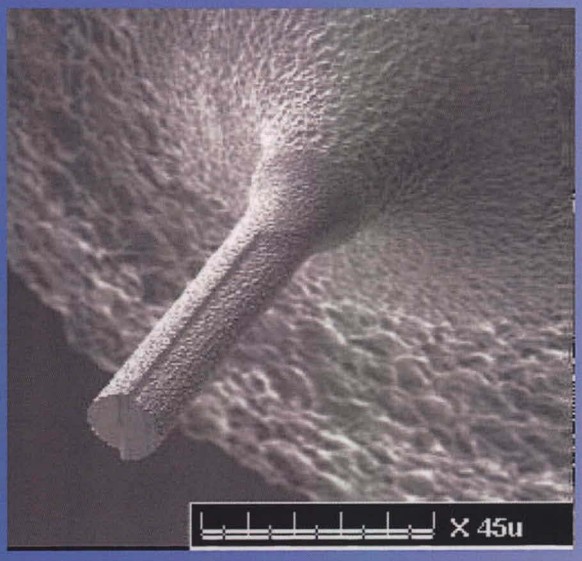
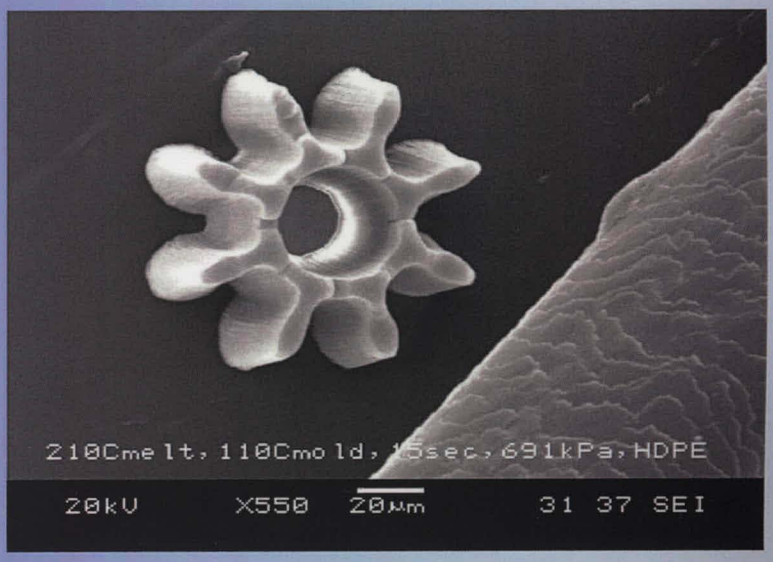
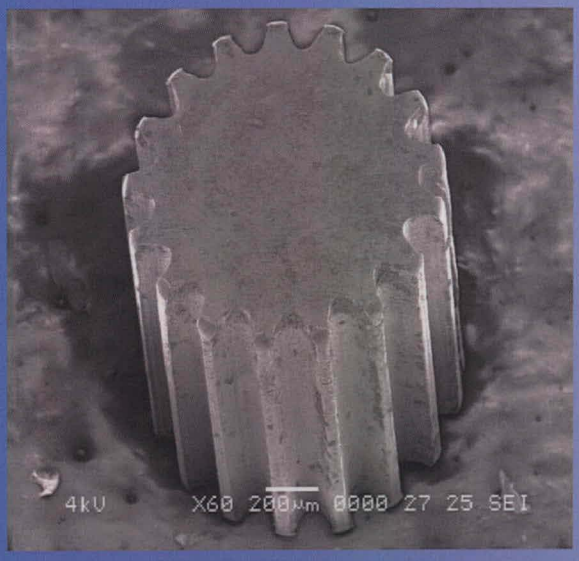
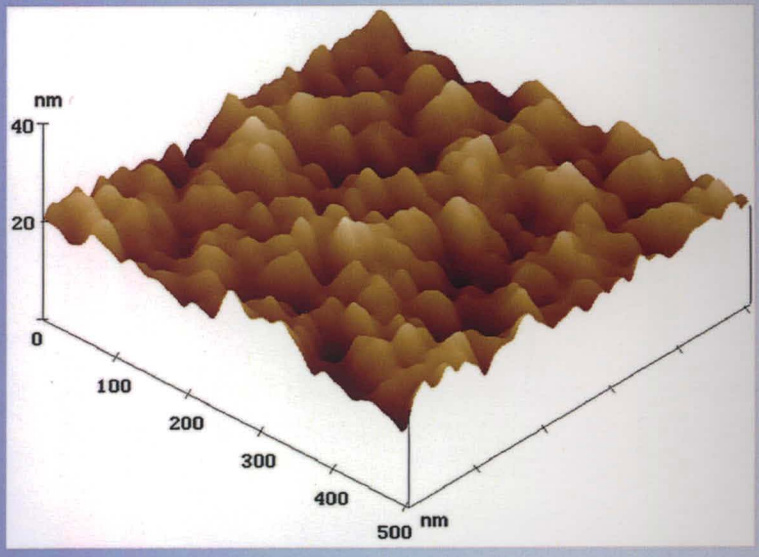
Advanced Machining Process









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Chapter 31

Precision Grinding of Silicon Carbide Using 46 μm Grain Diamond Cup Wheel

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Keywords: Silicon Carbide, ductile-mode machining, diamond grain size, cup wheel, surface roughness

Abstract. Grinding of Silicon Carbide (SiC) has been found difficult to be machined since the material is typically hard and brittle. Ductile mode machining has been developed to produce the better result of surface roughness for ground and brittle materials like SiC. Ductile mode grinding of brittle material has been and will continue to be in research area because of its increasing industrial applications. This project presents a study of precision surface grinding of SiC with varying machining parameters by employing ductile mode machining. The work-piece material was ground using a 76 μm cup wheel with aim of producing fracture-free surfaces of the ground work-piece material. The machining parameters chosen for the grinding process of SiC are depth of cut, feed rate and speed of the spindle. These parameters are used to explore the effects of the machining parameters on the machining characteristics, surface roughness and surface integrity.

Introduction

Hard and brittle materials are difficult to machine as they have high hardness and low toughness characteristics. Hard and brittle materials include Si, SiC, Aluminium oxide, zirconium oxide. Extensive research work has shown that diamond is the most suitable material used to machine hard and brittle materials since it has hardness that will provide wear resistance. Silicon carbide has low density, high strength, low thermal expansion, high thermal conductivity, high hardness, high elastic modulus, excellent thermal shock resistance, superior chemical inertness.

Advanced ceramic such as silicon carbide (SiC) is a carbon and silicon chemical compound. For over hundred years, SiC has been produced and made into grinding wheel because of its excellent abrasive. This SiC is produced by high temperature electro-chemical reaction of sand and carbon. It has good resistance to wear, thermal shock, and corrosion. It has also has low friction coefficient, and it retains high strength at elevated temperatures.
SiC is a type of ceramic and belongs to the class of hard and brittle material. Therefore machining it poses a real problem due to its low fracture toughness, making it very sensitive to crack. The efficient grinding of high performance ceramic involves the selection of appropriate operating parameters to maximize the material removal rate (MRR) while maintaining the low surface finish and limiting surface damage. Ceramics have very low fracture toughness, very sensitive to crack, so it is essential to distinguish which method should be used during machining the work piece. Venkatesh, V.C and Izman, S. [1] stated that machining of hard and brittle materials always poses problems. Blau et.al [2] mentioned that grinding can be classified as one of the most sophisticated machining process. Sanjay