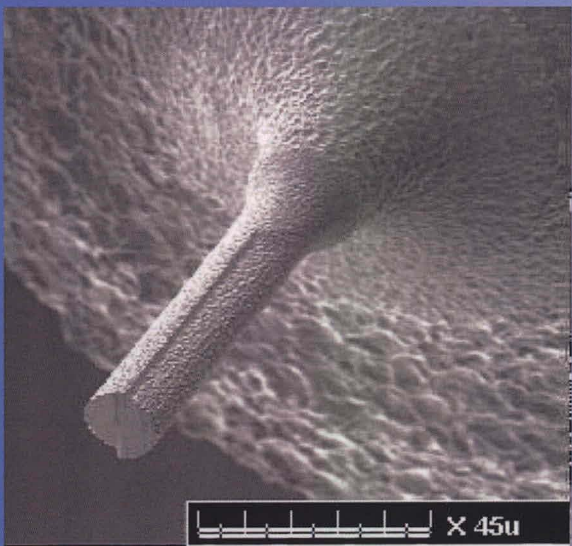
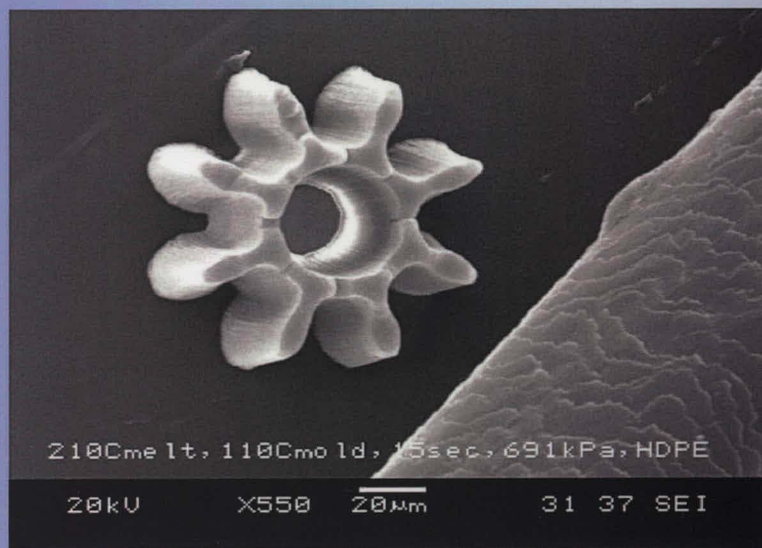
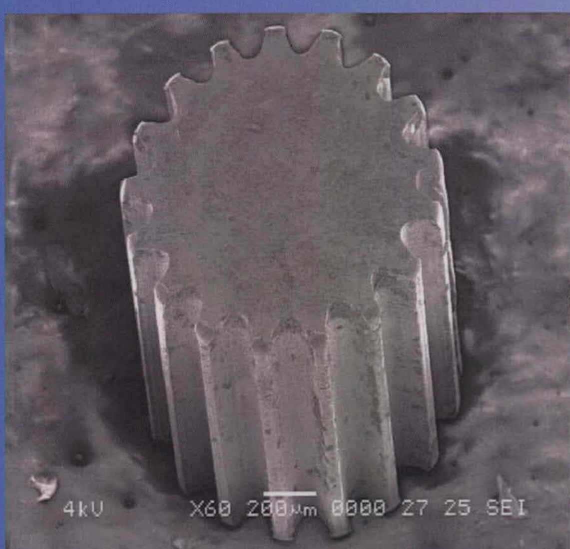
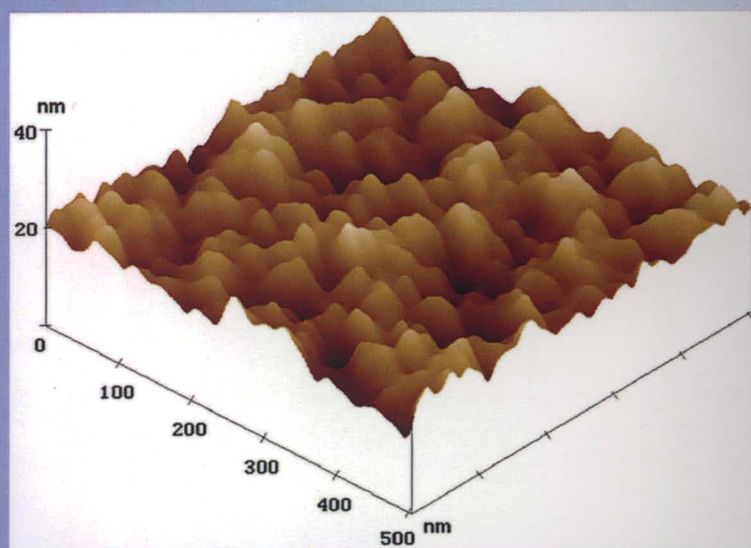
Advanced Machining Process









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Chapter 34

Investigation of Surface Integrity during Precision Grinding of Silicon Carbide using Diamond Grinding Pins

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Keywords: Silicon carbide, ductile-mode machining, grinding pins, surface integrity, surface roughness

Abstract. Ductile-regime machining has been studied by several researchers over the last two decades. Hence, the machining parameters, including depth-of-cut (DOC), feed rate, and grain size of the diamond pin should be chosen properly so that a better surface integrity can be obtained from the experiment. This project investigates experimentally the surface integrity of silicon carbide using diamond pin employing process of ductile mode machining. Grinding is used for conventional and finish machining, as it produces high quality surfaces and features. However, in machining brittle materials conventional process parameters may not be employed, as the materials crack on the surface and subsurface due to marks left by the motion of the tool. 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 resin bonded grinding pins 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.

High hardness, chemical stability, attractive high temperature wear resistance, low density and strength at elevated temperature are the advantages of ceramics over other materials. Ceramics such as silicon carbide have those properties plus it also has a high melting point which is 2730 °C. However, Agarwal and Venkateswara [1] revealed that those benefits of ceramics go along with some difficulties with machining in general and with grinding specifically because of its high values of hardness and very low fracture toughness as compared to other metallic materials and alloys. Silicon carbide (SiC) is a non-oxide ceramic in which the ratio of covalent bonding to ionic bonding is 9:1. In addition, low thermal coefficient of expansion and relatively high thermal conductivity are the special