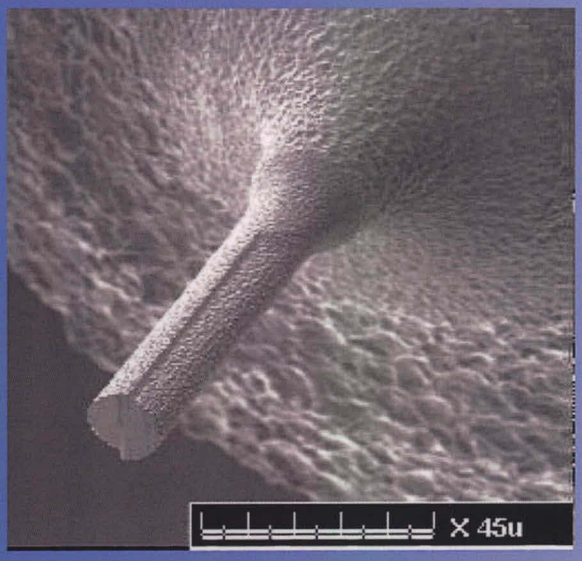
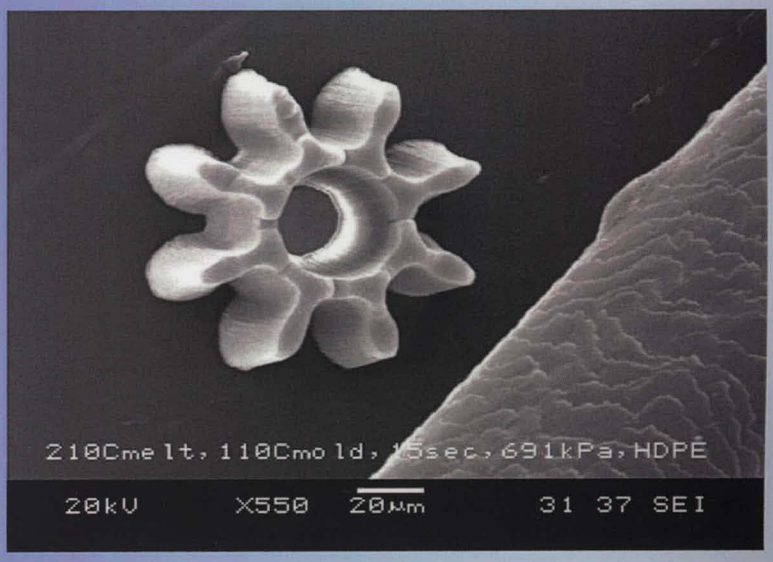
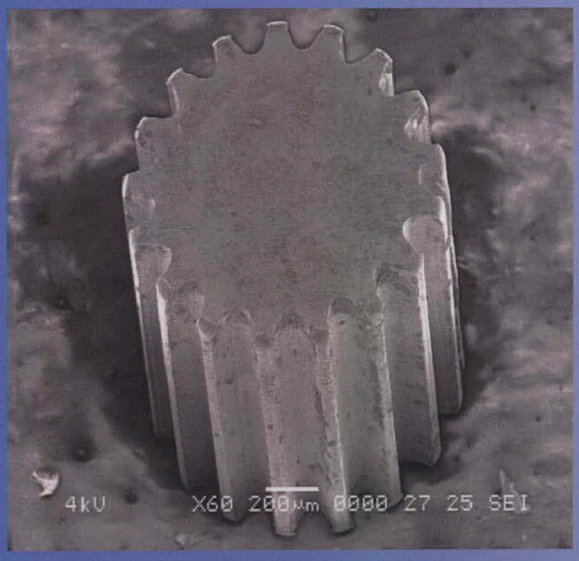
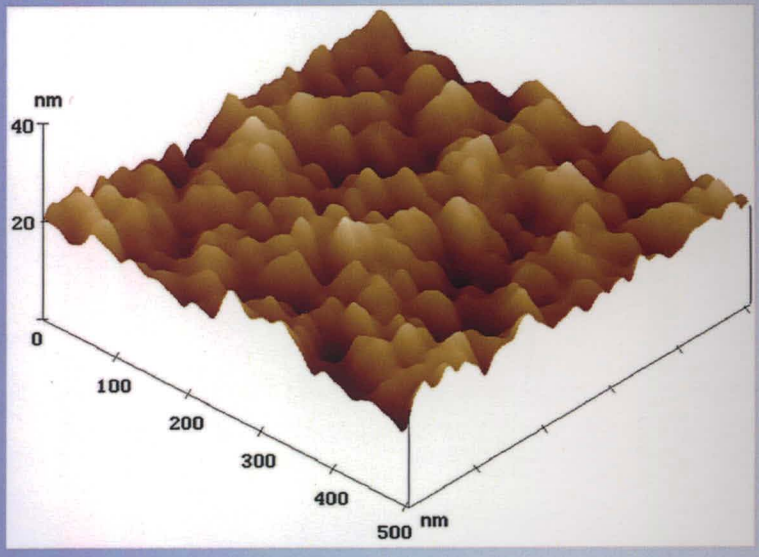
Advanced Machining Process









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Chapter 15

Focused Ion Beam Micromachining: Technology and Application

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Abstract. Fabrication of micro and nanoscale components are in high demand for various applications in diversified fields that include automotive, electronics, communication, medicine, environment, and biotechnology and engineering. Focused ion beam (FIB) machining is one of the techniques for microfabrication of micro devices. This paper presents a basic review of FIB machining technology, its important component systems, as well as the fundamentals of imaging, milling (etching) and deposition techniques. The application of FIB in microtechnology inspection, microtools fabrication and tunnelling gap milling is also presented.

Introduction

Focused ion beams (FIB) have been introduced to investigate the chemical and isotopic composition of materials since the 1960s [1]. In modern technology, the FIB is an extremely vital tool for semiconductor device manufacturing. It is also used to analyze the failure of a tool and design work, cross-sectioning of devices, maskless implantation and ion beam assisted etching [2]. FIB also has sputtering capability that can be used for machining of materials or tools at the micro- or nano-scales [1, 2]. The technology has also proven to be useful in fabricating microtools for microlathe and micromilling applications. In comparison to traditional techniques such as X-ray lithography or UV lithography which are intermediate operations used primarily in creating micro- to nano-scale features on silicon substrates, FIB is a high resolution technique that is able to write directly on any conductive substrates. FIB is able to machine high aspect ratio micro- to nano- features, whereby almost any geometry can be patterned in a single step. Furthermore, the FIB-patterned surface can be used as master stamps for subsequent soft lithography operations [1, 3]. The objective of this paper is to present an overview of the FIB system and the working principal as well as the application.

Focused Ion Beam System

In FIB, an ion beam with specific intensity and diameter is directed to the substrate material for micro or nano fabrication processes [2]. Figure 1 shows the most important components in an FIB system: