Processing of MEMS and NEMS

Abstract

This chapter is mainly focused on the processing of MEMS and NEMS. An introduction to the MEMS and NEMS is presented first, followed by fundamentals such as scaling, mechanical properties, microfluidics flow and lubrication at micro/nano-scale. A brief look at the modeling of MEMS as well as the applications of MEMS and NEMS including the description of some of the more common devices is provided. Processing methods for the fabrication of MEMS and NEMS including silicon bulk and surface micromachining, microstereolithography, LIGA and electrodeposition are described under the main focus of the chapter. Reliability of MEMS structures is briefly discussed at the end. The chapter is concluded with a brief summary and a comprehensive list of references.

Introduction

The recent-years exponential growth of MEMS and NEMS market has prompted a closer look at processing and reliability of the micro- and nanoscale devices. Silicon as the primary material for fabrication of micro devices is known to suffer fatigue failure in ambient atmosphere where moisture is present. A brief discussion of silicon properties will be presented, followed by fundamentals of MEMS and NEMS including materials properties that are affected by scaling.

Scaling

Three main scales have been indentified in today’s technology: macro-, micro-, and nanoscale, corresponding to meter, micrometer and nanometer respectively. While macroscale