INTEGRATION OF PIEZOELECTRIC Pb(Zr\textsubscript{x}Ti\textsubscript{1-x}) O\textsubscript{3} (PZT) THIN FILMS INTO MICROMACHINED SENSORS AND ACTUATORS
Chapter 1

INTEGRATION OF PIEZOELECTRIC Pb(Zr_xTi_{1-x})O_3 (PZT) THIN FILMS INTO MICROMACHINED SENSORS AND ACTUATORS

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Abstract: This chapter presents an overview on integration processes that have been developed for the fabrication of planar silicon structures coated by textured piezoelectric Pb(Zr_xTi_{1-x})O_3 (PZT) thin films. Key issues are the textured growth to achieve high piezoelectric coefficients and the stress compensation to control the bending of cantilevers as well as the stretching forces at membranes. Advanced dry etching techniques are needed for patterning the electrode films without damage to PZT, and without leaving residues. Some recent results on cantilever-microphone and piezoelectric micromachined ultrasonic transducer (pMUT) are presented.

Keywords: piezoelectricity, PZT, MEMS, microfabrication, dry etching

1. INTRODUCTION

Piezoelectric thin film actuation and sensing are useful in devices requiring large output forces, low noise, or high frequency operation (see [1] for a review). An additional advantage lies in the fact that a planar structure (one level) is able to give excursion and strain detection in the out-of-plane direction, which is very useful in scanning probe techniques [2], for instance. Today, there is a growing interest in the field of micro-electro-mechanical systems (MEMS) for the integration of smart materials with good actuation and/or sensing capabilities. In particular, Pb(Zr_xTi_{1-x})O_3 (PZT) and AlN thin films are of primary interest [3]. PZT is a favorite material when the force or the output charges are of importance. AlN is very suitable for RF-MEMS applications in the GHz frequency range, or when compatibility with silicon