

4 Silicon-Based Microelectromechanical Systems (Si-MEMS)

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73 **4.1 INTRODUCTION**

74 Microelectromechanical systems (MEMS), also known as microsystems technology (MST), has
 75 seen an explosive growth during the past two decades. Miniaturizing technology with benefits such
 76 as new functionality, cost reduction, and space saving, has helped MEMS applications span over
 77 numerous fields including automotive, aerospace, photonics, telecommunications, life sciences,
 78 biochemistry, biology, biomedicine, and drug delivery to name a few. When it comes to sensors
 79 and actuators, MEMS is a strong competitor for the conventional manufacturing processes. When-
 80 ever a new functionality becomes possible by going small (e.g., biological applications), or when
 81 mass production at small scale reduces production costs (e.g., automotive applications), or when
 82 space is a major constraint (e.g., aerospace applications), utilizing MEMS becomes an obvious
 83 choice. This chapter focuses on Si-based MEMS with the main emphases placed on silicon proper-
 84 ties, device fabrication, device applications, and the related mechanical and reliability
 85 related issues.
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89 **4.2 MATERIALS**

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91 **4.2.1 SILICON**

92 Silicon is the material of choice for most MEMS devices. This arises mainly from the economic
 93 benefits due to the well-established semiconductor manufacturing technology that provides the
 94 industrial infrastructure needed for MEMS fabrication. This is in addition to the desirable properties
 95 of silicon including electrical, optical, and mechanical, linked to various crystal structures. The
 96 well-established micromachining techniques with additive and subtractive processes make the
 97 design and mass production of Si-MEMS easy and economical. Si-based MEMS may have other
 98 materials that are compatible with silicon. These include silicon oxides, silicon nitrides, silicon
 99 carbides, and metals such as Al, W, Cu, and polymers such as polyimide.
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