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Advanced Ion Beam Trimming Technologies for Recent and Newly Developing MEMS-Applications

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An increasing variety of MEMS devices have to fulfil tighter specifications year by year. Bandwidths for RF filters shrink continuously to meet the higher demands for wireless data communication. The internet of things will require operation of simultaneous adjacent wireless communication channels without interference. In addition, a rapid increase in numbers of new sensors and actuators will require high performance under challenging environmental conditions. Many of these MEMS devices will need a highly precise control of structural dimensions or film thickness. For a few of the manufacturing steps of such MEMS devices ion beam milling is applied, especially where nanometer precision, or sometimes sub-nanometer precision, is required. The physical nature of ion beam milling allows for a wide variety of materials to be processed. A specialized version of ion beam milling, where material can be locally and selectively removed from different parts of a wafer, is known as Ion Beam Trimming (IBT). Ion beam trimming of RF-MEMS devices is a well-established manufacturing technique in the industry. Certain further activities for yield improvements will be shown, such as new chucking techniques and reactive processing. The authors will describe the working principles of these technologies and present application examples. Beyond established usage, ion beam trimming has found new applications in manufacturing of advanced RF-MEMS like temperature compensated SAW devices and Murata's incredible high performance SAW devices based on bonded wafers. The application market has extended from device manufacturers to wafer material providers. From that, new end products can be targeted, but new cost challenges rise as well. The higher achievable accuracy of Silicon on Insulator (SOI) film thickness homogeneity will enable better yields and precision in sensor manufacturing. Actuator production may gain advantage from that advanced film quality as well. Examples will be given for both.

Keywords

ion beam trimming

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