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Optimization of miniaturized silicon microphones using a two-wafer approach

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A two-wafer concept is proposed for the fabrication of silicon microphones with emphasis on deep reactive ion etching and wafer bonding techniques. For miniaturized sensor structures with an air gap of 1-2 microns, the viscous damping effect dominates the dissipation mechanism, which can have an adverse influence on the microphone performance, namely frequency response characteristic and mechanical-thermal noise. Therefore, an optimum microphone performance has its origin in a well-designed backplate structure. A silicon backplate with carefully placed acoustic slots and holes is attached to a silicon nitride/metal-based diaphragm. An impediment to achieve high sensitivity is the residual stress that is presented in the diaphragms. Besides the process optimization of less stress silicon nitride layer and the introduction of corrugated diaphragm, an investigation is carried out to determine the effects of sputtering parameters of Cr/Au metal electrode film (thickness, sputtering process pressure and process power) on the residual stress of silicon nitride/metal diaphragm. Details of modeling, fabrication and experimental results will be presented.