approach is one part of the final packaged pressure sensor. In contrast, the patterned photoresist for sacrifice-replacement approach is temperately deposited in the packaging body, and it has to been removed from the packaged pressure sensor. The dam-ring approach eliminates an extra removal process of the completely cured photoresist, improving the packaging throughput compared with the sacrifice-replacement approach. In general, to remove a photoresist with completely cured is more difficult than that with just soft-baked. In comparison with sacrifice-replacement approach, the dam-ring approach is suitable for application of other open-cavity sensors, such as gas sensors. Because the photoresist residual on the sensing material layer of the gas sensors will reduce the effective sensing surface area and degrade the sensing performance at the same time. In this study, the sensing feature, the packaged pressure sensor using the dam-ring approach has a similar packaging feature compared with that using the sacrifice-replacement approach, if the same sensing channel opening is designed. However, the photoresist used for sacrifice-replacement approach just covers the sensing active area of the sensor chips only, such as the silicon membrane area for a pressure sensor. The sacrifice-replacement approach is suit for the sensor chip having small total chip size and large sensing active area.

5. Conclusions

This study demonstrated a novel pressure sensor packaging using patterned ultra-thick photoresists. The photoresist materials used for both sacrifice-replacement and dam-ring approaches can prevent the sensing-channel of the pressure sensor packaging from EMC contamination under molding transfer conditions of 165 °C and 1.86 MPa. The thermal signal drift of the packaged pressure sensors with a large sensing-channel opening for sacrifice-replacement approach significantly reduced packaging induced thermal stress, and hence a low TCO response of -0.065% span/°C. Both packaged pressure sensors of sacrifice-replacement and dam-ring approaches still met the specification -0.2% span/°C of the unpackaged pressure sensor. In addition, the size of proposed packages was $4 \times 4 \times 1.5$ mm^3 which was about seven times less than the commercialized packages.With the same packaging requirement, the proposed packaging approaches can be an adequate solution for use in other open-cavity sensors, such as gas sensors, image sensors, and humidity sensors.

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