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Determination of Thermal Expansion Coefficient of Thermal Oxide

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An accurate thermal expansion coefficient (α) of a thin film is important in the design of microelectronic devices and microsystems. In this research, we present the use of microbridge buckling deformation caused by residual stresses to determine the α of a thermal oxide (SiO_2) film. The determination of α is supported through experimental means and the analysis by finite-element method (FEM) of the buckling profiles of a microbridge. Moreover, to obtain the α of a thermal SiO_2 film accurately, a nanoindentation system and an optical microscope with a high-resolution gauge were used to determine the elastic modulus of the thermal SiO_2 film and the α of the silicon substrate, respectively. By combining micro-electro-mechanical systems (MEMS) technologies and FEM with thermo-mechanical analysis, the α of the thermal SiO_2 film was calculated. The measured α of the thermal SiO_2 film at room temperature is 0.24×10^{-6}/°C with a standard deviation of 0.02×10^{-6}/°C.

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