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Optimization of the Microstructure of NiTi Shape Memory Alloy thin Films in the Aid of in Situ TEM

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The crystallization and phase transformations of amorphous NiTi thin films were studied using in situ transmission electron microscopy (TEM). These films were sputter-deposited onto micromachined silicon-nitride membranes and subjected to heating and cooling conditions. The microstructural evolution was monitored and recorded during heating and cooling. Kinetic parameters such as the nucleation rate, the growth rate, and the area-fraction transformed were independently determined by noting the number of grains per frame and their change in size. Using the Johnson-Mehl-Avrami analysis, fitted kinetic parameters were determined and found to be consistent with TEM observations. With cooling, we observed directly the conversion of the high temperature phase (austenite) to its low temperature phases (R-phase and martensite). To explore the compositional sensitivity of crystallization, samples near-equiatomic and slightly Ti-rich were studied with these methods. TEM micrographs show that equiatomic films exhibit polymorphic crystallization. However, samples that are slightly off-stoichiometry did not exhibit this behavior.

Keywords: TEM

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Bonding Solutions for Wafer-Level MEMS Packaging

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In addition to the functions of conventional semiconductor packaging, the packages for MEMS devices should provide additional functions; a cavity to hold the devices, hermetic sealing to protect them from external environment, and optical transmission to operate optical devices. Wafer-level (WL) MEMS packages are usually embodied with a wafer-level bonding between a bottom wafer including MEMS device and a cap wafer having cavity structure to hold the MEMS devices. Hermetic sealing, as well as electrical interconnection, can be simultaneously achieved by WL bonding process. The MEMS packages are fabricated using typical 3D packaging processes; formation of through-silicon-via (TSV), filling of TSV using Cu electroplating, and wafer thinning and so on.

In the presentation, various kinds of bonding solutions, such as Si direct bonding, anodic bonding, and eutectic bonding, are introduced. They are developed to provide suitable bonding solutions at various temperature ranges. Among them, eutectic bonding solutions, such as Au-Sn, Cu-Sn, and Au-In system, are highlighted. Basic concept of hermetic package and measurement technique of hermeticity are also explained. Helium fine leak test is used to provide accurate standard for the order of hermetic sealing.

Keywords: bonding, WL packaging, MEMS, hermetic sealing