High-performance Condenser Microphone with Single-crystalline Silicon Diaphragm and Backplate

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This paper presents a high-performance silicon condenser microphone fabricated with a new process using single-crystalline silicon. This simple fabrication process, which requires only two photolithography steps and two wet-etching steps, is suitable for low-cost mass-production. We designed the structure of a high-performance microphone and simulated it with an equivalent acoustic-circuit model. We then fabricated a prototype microphone based on this design, and experimental measurements on the prototype confirmed its excellent acoustic characteristics such as high sensitivity of -43.5dB, wide frequency range of 30Hz to 20kHz, and high maximum sound pressure level (1kHz at 1% THD) of 122dB$_{SPL}$. The measured equivalent noise (A-weighted) is 30.5dBA$_{SPL}$. The measured frequency responses showed good agreement with those estimated from the simulation, indicating that the high controllability of the process enabled us to fabricate the prototype as we designed it. These results show that it is feasible to economically mass-produce such high-performance microphones for purposes ranging from broadcasting to consumer use.

Current Induced Magnetization Reversal in Spin Valves with Heusler Alloys

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Current induced magnetization reversal with current-perpendicular-to-plane (CPP) spin-valve devices which include Heusler alloys, such as Co_2MnGe, Co_2FeSi were investigated in a comparison with conventional $Co_{75}Fe_{25}$ alloys. Heusler alloys are very attractive because of their possibility to reduce the switching current for their expected large spin polarization and low saturation magnetization, which is necessary for spintronics devices such as Gbit magnetic random access memory. Film stacks of $Si/SiO_2/Cu/IrMn/Heusler\text{-}pinned\text{-}layer/Cu/Heusler\text{-}free\text{-}layer$ were deposited by DC magnetron sputtering followed by post-annealing. Saturation magnetization (B_s) of Co_2MnGe, Co_2FeSi, and $Co_{75}Fe_{25}$ are 12.7 kG, 14.0 kG, and 25kG, respectively, and MR ratios of spin valves with the Co_2MnGe, Co_2FeSi, and $Co_{75}Fe_{25}$ are 3.6%, 3.5%, and 2.2%, respectively. The B_s values and MR ratios obtained for Co_2MnGe and Co_2FeSi spin valves were smaller and larger, respectively than those obtained for $Co_{75}Fe_{25}$. We speculated that the large MR ratios could be attributed to larger spin polarization of Heusler alloys. Critical switching current density, J_{c0}, of Co_2MnGe, Co_2FeSi, and $Co_{75}Fe_{25}$ spin valves were $1.6\times10^7 A/cm^2$, $2.7\times10^7 A/cm^2$, and $5.1\times10^7 A/cm^2$, respectively, while the thermal factors of these were 65, 48, and 55, respectively. Using the Heusler alloys, we successfully reduced the J_{c0} without degrading the thermal factor.