Heusler alloy based magnetoresistive devices

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The hard disk drive industry is making continuous efforts to increase the areal density of magnetic recording. To realize the areal density of higher than 2 Tbit/in^2, the shield-to-shield spacing of read sensors must be smaller than 20 nm with low device resistance (resistance-area product RA~0.1 Ωμm^2), which is very challenging goal for MgO-based TMR devices. There are two approaches to achieve low-RA high-MR devices; one is to reduce RA of tunneling magnetoresistive devices using low resistance barrier and the other is to enhance MR output of current-perpendicular- to-plane giant magnetoresistive (CPP-GMR) devices using half-metallic ferromagnetic layers. We explored several Co-based Heusler alloys with high spin polarization for ferromagnetic layer applications and new barrier and spacer layers that can enhance MR outputs in TMR and CPP-GMR devices. To extract the highest MR outputs that can be expected intrinsically from the combination of the ferromagnetic and nonmagnetic materials, we characterized the interface structures of layered devices using aberration corrected STEM with a near-atomic resolution to understand the structure-property relationships. In this talk, I will overview the current status and perspectives of low-RA high-MR devices for reader applications.

Kazuhiro Hono received the BS and MS degrees in Materials Science from Tohoku University in 1982 and 1984, and a Ph.D. degree in Metals Science and Engineering from Penn State in 1988. After working as a post doc at Carnegie Mellon, he became a research associate at the Institute for Materials Research, Tohoku University in 1990. He moved to the National Institute for Materials Science (NIMS) as a senior researcher in 1995, and is now a NIMS Fellow and the Director of the Research Center for Magnetic and Spintronic Materials. He is also a professor in Materials Science and Engineering at the University of Tsukuba. His current research interest is materials science in magnetic and spintronics materials and their devices.