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Magneto-plasmonics on perpendicular magnetic nanostructures consisting of CoPt nano-layer and noble-metal nanoparticles

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The interaction between Magneto-Optical (MO) activities and plasmons has been intensively investigated from fundamental and applied viewpoints. Improvement of the MO effect is desirable in practical applications such as information storage systems, telecommunications and chemical and biological sensors. In this presentation, the MO properties of perpendicular magnetic nanostructures consisting of a hexagonal close-packed Co80Pt20 nano-layer and noble-metal (Ag or Au) nanoparticles were investigated under polar Kerr measurement conditions. The samples exhibited an unusual MO hysteresis loop in which the Kerr rotation angle increased at a low magnetic field; this effect was observed at a different wavelength region for the CoPt-Ag and CoPt-Au samples. The nanostructures consisted of two magnetic regions of CoPt layers formed on the nanoparticles and on the underlayer. The increase in the Kerr angle was induced by the antiparallel magnetic alignment of these CoPt layers. The opposite MO polarity on the CoPt nanostructures was suggested also in a micro-MO observation using scanning near-field polarized optical microscopy. The Ag and Au nanoparticles induced the MO phase reversal at a different wavelength region for each plasmon excitation. The MO behaviors on the CoPt nanostructure are attributed to the influence of localized surface plasmons excited on the noble-metal nanoparticles. The magneto-plasmonic activities on the nanostructures were also changed by the underlayer material and the external environmental conditions. We have demonstrated the magneto-plasmon sensor consisting of the CoPt-Ag by detecting the change in external environment (optical index) and a new detection parameter using MO activities has been proposed. The perpendicular magnetic nanostructures are expected to provide a new type of probe for chemical and biological sensing applications.

Recent Publications

1. H Yamane, K Takeda and M Kobayashi (2016) Magneto-optical enhancement and chemical sensing applications of perpendicular magnetic CoPt/Ag stacked structures with a ZnO intermediate layer, materials transactions. *The Japan Institute of Metals;* 57: 892-897.
2. H Yamane, K Takeda and M Kobayashi (2015) Magneto-plasmonics on perpendicular magnetic CoPt-Ag nanostructures with ZnO intermediate thin layers. *Applied Physics Letters*; 106: 052409.

Biography

Haruki Yamane has completed his BSc degree in Physics from Ehime University in 1987 and his PhD from School of Engineering, University of Tokyo in 1996. His research interests include magnetic properties of nanostructures and photonic devices using magneto-optical activities. He is a Member of the Japan Society of Applied Physics, The Magnetic Society of Japan and The Japan Institute of Metals and Materials. Currently he is working as a Research Officer at Akita Industrial Technology Center, Japan.

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