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Magnetic properties of Fe_3Al films, investigated by Brillouin light scattering

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Iron aluminides based on DO_3-type, such as Fe_3Al, have been under intensive investigations for their possible uses as high-temperature structural materials. Fe_3Al alloys are also known to have peculiar magnetic properties at high pressures. Brillouin light scattering (BLS) has been successfully applied not only to study the collective spin-wave (SW) excitations, but also to determine several magnetic constants, such as g-factor, exchange coupling constants, bulk magnetization and surface magnetization, for various magnetic thin films. In this study, the magnetic constants of $(Fe_{0.7}Ni_{0.3})_3Al$ and Fe_3Al films were determined from the BLS spectra, and compared with the results using a superconducting quantum interference device (SQUID). To investigate the SW dispersion relation, the spin-wave frequency for each mode is measured as a function of magnetic field. Then, the frequencies of surface and bulk spin wave are analyzed by using an analytic expression, based on dipole-exchange model. The SW stiffness (D) is evaluated to be 168.6 and 52.6 meV·A^2 for Fe_3Al and $(Fe_{0.7}Ni_{0.3})_3Al$ films, respectively. The SW stiffness constants of Fe_3Al film, according to both the SQUID and the BLS measurements, are larger than the corresponding ones for $(Fe_{0.7}Ni_{0.3})_3Al$ film. This implies that the exchange interaction between magnetic atoms in the $(Fe_{0.7}Ni_{0.3})_3Al$ film becomes weaker with respect to the Fe_3Al film, since D is proportional to the exchange interaction.