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Magnetic Circuit for the Magnetic Actuator and Electrical Generator by Means of Magnetostriction Alloy

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Novel magnetic circuit, which is combined with AC and DC magnetic fields, has been developed for the actuator by means of magnetostriction alloys. This magnetic circuit is also useful for high field creation for the nano laboratory or micro laboratory. The material of the yoke of the circuit was 99.99% pure Iron (Fe) and two coils were used for AC magnetic flux density. In order to adjust the DC fields, few ferrite magnets were used. Using this circuit, the magnetic flux density up to 1 T was generated in an aperture of 6.0 mm width and 2.0×2.0 mm square.

Terfenol-D, which shows large magnetostriction, was established into the aperture of the magnetic circuit and AC magnetic flux density were applied by flowing the current of the electricity into the coils. We designed two type actuators. One is the actuator under the atmospheric pressure. The magnetostriction of Terfenol-D in this actuator is 680 ppm, which corresponds 4.0 μm displacement for 20 V_{pp} output from an audio amp as use of power supply. The minimum displacement is 2 nm in 1 mV, which indicates that this magnetic actuator can be useful for nano meter activations for nano science and technology. The other is the actuator, which is applied uniaxial stress to the Terdfenol-D. This is 20×20×20 mm size and the activation length is 11 μm.

The electric power generation system was also designed by means of the magnetic flux density change due to the magnetostriction. With exerting an impulsive force of 80 N, 24 mW electricity was generated. This generator is considered to be useful for the generator for the sensors or auxiliary lights of motorcars and trains.

Key Words : nano technology, magnetostriction, magnetic circuit, magnetic actuator, magnetic flux density