

## MTJ device using FeSiAl alloy

High TMR, high sensor sensitivity and cost reduction can be realized using FeSiAl alloy. Low  $H_k$  can be obtained for FeSiAl films with wide composition range.

### Overview

TMR sensor is known to be a high sensitivity magnetic sensor which uses the tunnel magnetoresistance effect (TMR) in magnetic tunnel junctions (MTJs). The TMR sensor performance can be controlled by controlling the magnetic anisotropy ( $H_k$ ) of the free layer. Therefore, it is expected to be applied to the bio-magnetic measurement device that detects the weak magnetic field of a living body at room temperature, the battery level detector for electric vehicle, non-destructive inspection to detect the rupture or deterioration of reinforcing steel bar in concrete structure, etc.

NiFe alloy, CoFeB alloy and CoFeSiB alloys have been conventionally developed as free layer of MTJ devices for TMR sensor, but higher sensitivity and lower cost are required.

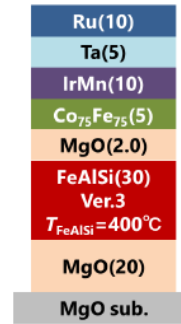
This invention focused on FeSiAl alloy (Sendust) to produce the Sendust thin film of nanometer order thickness which was not able to fabricate. Therefore, this alloy is applied to the free layer to fabricate the MTJ devices that achieve the same level of sensor sensitivity as NiFe alloy, etc. It has been also revealed that the soft magnetic property is excellent over a wider range of composition compared with conventional Sendust.

### Product Application

- Biomagnetic measurement device for heart, brain, etc.
- Non-contact / low electrical power / high sensitivity remaining battery level detector for electric vehicle
- Magnetic sensor for non-destructive inspection to detect rupture or deterioration of reinforcing steel bar in concrete structure

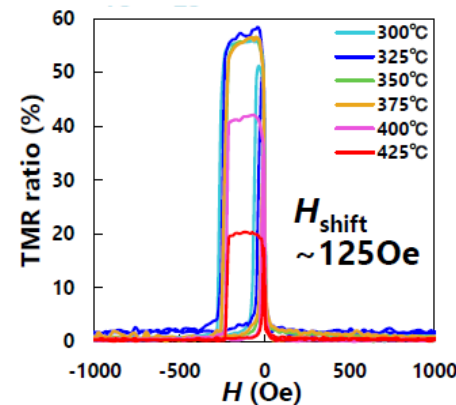
### IP Data

IP No. : JP2022-94518  
 Inventor : OOGANE Mikihiro, AKAMATSU Shoma, ANDO Yasuo, KUMAGAI Seiji  
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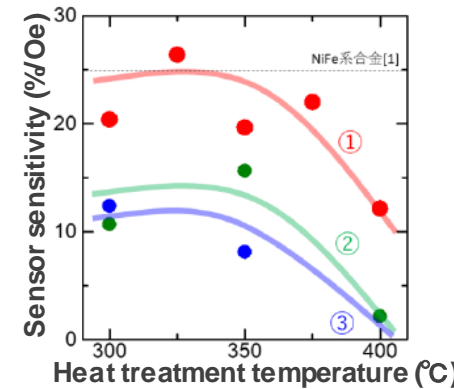


← Schematic diagram of MTJs using Sendust thin film as free layer

### Maximum TMR ratio and sensor sensitivity after heat treatment at specific temperatures



↑ TMR ratio of MTJ element



↑ Sensor sensitivity comparable to that of MTJs using NiFe alloy

### Related Works

- [1] Kosuke Fujiwara, Mikihiro Oogane, Saeko Yokota, Takuo Nishikawa, Hiroshi Naganuma and Yasuo Ando, J.Appl. Phys. 111, 07C710 (2012)  
 [2] Shoma Akamatsu, Mikihiro Oogane, Masakiyo Tsunoda, et al. AIP Advances 10, 015302 (2020)

### Contact