ポリジメチルシロキサン上のフレキシブルスピン素子

Flexible spin device on dimethylpolysiloxane sheet

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[Introduction] Internet of Things (IoT) devices are important technology to connect between humans and things. Especially, spintronics devices with sufficient flexibility are useful because they can place on curved surfaces and human skin. In fact, flexible strain gauge based on spintronics technology has been reported. [1, 2] If we use IoT device on human skin, the biocompatible material should be used as substrate. Here, the biocompatible PDMS (dimethylpolysiloxane) with sufficient flexibility can be bonded to polyimide, which has large heat resistance. In this study, we propose the spin torque oscillator with flexibility, which can be used as the transmitter in the IoT device, on PDMS.

[Experiment] We used polyimide film as a flexible substrate. The polyimide film was obtained by a spin coating method using polyimide varnish on the thermally oxidized Si substate cleaned by Ar ion etching. The polyimide film was too thin to apply fabrication process if Si substrate is removed. Therefore, we used polyimide film on Si substate during fabrication process. Finally, the polyimide film is peeled off and attach to PDSM. Then, the polyimide film was annealed to polymerize polyimide varnish. Ta/Pt/Ta/NiFe/IrMn/Co/AlO_x/Co/NiFe/Ta multilayered film was deposited on the polyimide film with Si substrate by a DC sputtering method. The device pattern was fabricated by a photolithography and Ar ion milling. After that, the polyimide film was peeled off from the Si substrate. Finally, the polyimide film was bonded to PDMS. The bonding process is as follows. First, APTES (3-Aminopropyltriethoxysilane) diluted by distilled water was dropped to PDMS after oxygen plasma was applied to PDMS. Then, the polyimide and PDMS were bonded. [3]

[Results] The roughness of polyimide film on the Si substrate was measured by atomic force microscopy (AFM) and the root mean square roughness is 0.3nm, which indicates sufficient flatness. Fig. 1 shows a photograph of the polyimide film with patterned magnetic multilayer on PDMS. We successfully obtained the STO elements on the sufficient flexible and biocompatible substrate.

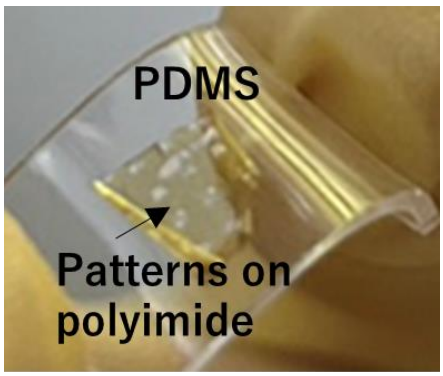

Fig. 1 Photograph of PDMS with patterns on polyimide film.

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