CoFeB/MgO-based magnetic tunnel junction directly formed on a flexible substrate

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To endow spintronic devices with a stretchability will further expand a possibility for applications[1,2], which will be of increasing importance as internet of thing (IoT) devices. The stretchability of both the substrate and thin metallic ferromagnetic layers enables strain sensing on a wide range of arbitrary-shaped surfaces, which has been not easy when using spintronics devices formed on a rigid semiconductor substrate. These stretchable and miniaturized strain sensors are expected to open an entirely new route of future spintronics from the perspective of the trillion-sensor universe.

Here we succeeded in fabricating a CoFeB/MgO-based magnetic tunnel junction (MTJ) directly on an organic flexible substrate.[3,4] As the annealing temperature increases, the tunnel magnetoresistance (TMR) ratio enhances and reaches up to ~200% at an annealing temperature of 450 °C. The TMR ratio shows no change during and after a 1000-cycle application of a tensile strain larger than 1%. The magnetic anisotropy fields for the top and bottom CoFeB layers are linearly proportional to strain with almost the same rate as that in a single CoFeB film, suggesting that the expected strain is added on both CoFeB layers in the MTJ pillar from the stretched flexible substrate. The high TMR ratio and strain endurance demonstrated in this study show that the flexible MTJ structure is a promising candidate for a future wearable sensing device.

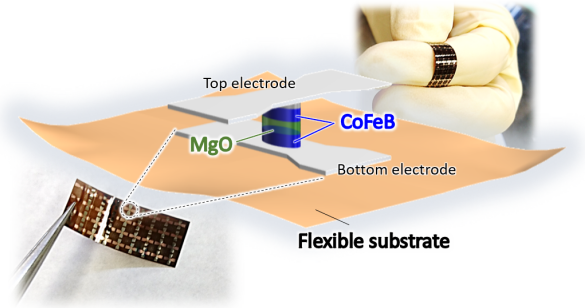

Fig.1 Schematic of our flexible MTJ.

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