

# Substrate Effect on Magnetothermoelectricity of CoFeB/Pt Heterostructures

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## 1. Introduction

Magnetothermoelectric effect has gained a growing attention in accordance to the importance of energy-harvesting technology. The interplay of spin, electron, and phonon under thermal gradient is still under active exploration, and the origin of magnetothermoelectric effect in ferromagnet/nonmagnet metal system is still under debate. Interestingly, recent reports showed that magnetothermoelectric effect in Py, Py/Pt, and CoFeB/MgO-based magnetic tunnel junction was dependent on the substrate like glass, Al<sub>2</sub>O<sub>3</sub>, MgO, GaAs, and Si/SiO<sub>2</sub> due to the effect of thermal conductivity mismatch [1], acoustic pumping [2], in-plane/out-of-plane temperature gradient [3], and capacitive coupling [4]. Hence, it is interesting to study these effects in a different ferromagnet/nonmagnet metal system of CoFeB/Pt heterostructures.

## 2. Experimental method

For this study, Co<sub>32</sub>Fe<sub>48</sub>B<sub>20</sub> (CFB) and Pt were deposited on glass, Al<sub>2</sub>O<sub>3</sub>, MgO, and Si/SiO<sub>2</sub> substrates, and then patterned into a stripe structure with 0.1-mm width by optical lithography for electrical detection. Thermoelectric voltages induced by different local heating positions were measured perpendicularly to both magnetization and thermal gradient in sweeping magnetic field. Laser power, wavelength, and its spot size are 27 mW, 532 nm, and ~5 μm, respectively. Figure 1(a) shows the schematic diagram of the experimental configuration.

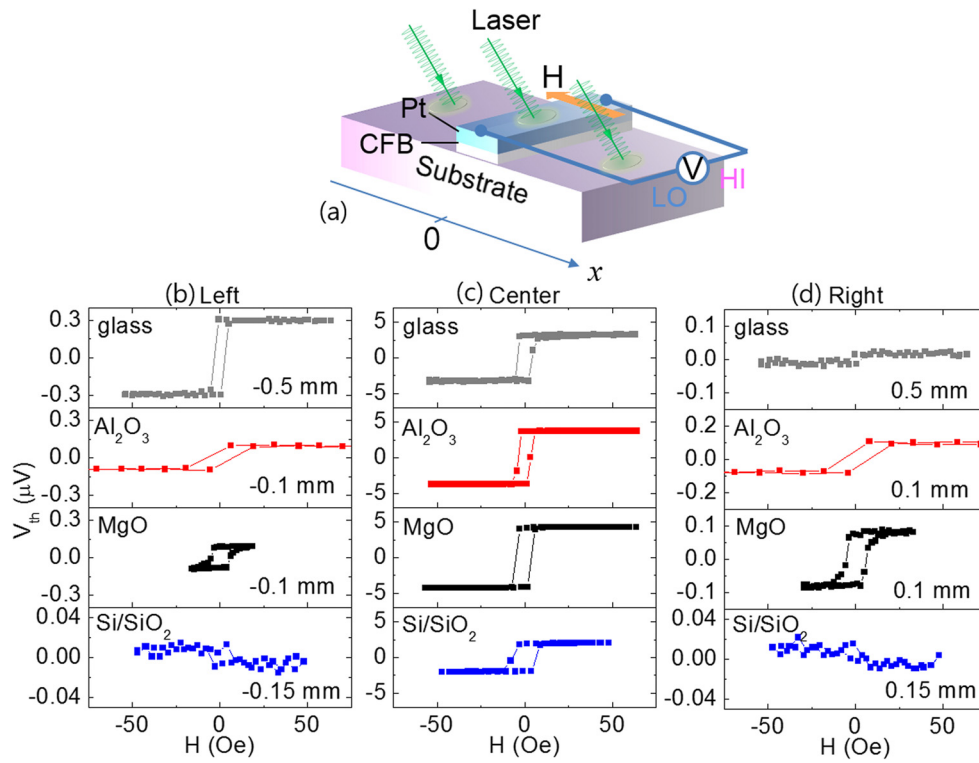
## 3. Result and discussion

Figures 1(b), (c), and (d) show the thermoelectric voltage after subtracting the offset, when the laser heating position is left, center, and right from the center of the stripe. All show changes of thermoelectric voltage upon reversal of the magnetization. As shown in Fig. 1(c), the different level of the thermoelectric signal among different substrates were observed possibly due to the thermal conductivity mismatch. Magnetothermoelectric voltage was found to be observed even when only the substrate was directly heated. Intriguingly, sign conversion of voltage curve between center and left/right heating was witnessed in case of Si/SiO<sub>2</sub> substrate.

## 4. References

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**Fig. 1.** (a) Schematic diagram of the experimental configuration. (b)-(d) Magnetothermoelectric voltage of CoFeB/Pt, when the laser spot positioned at (b) left, (c) center, and (d) right of the stripe structure.