Supporting Information for

Modulation of surface plasmon coupled emission (SPCE) by a pulsed magnetic field

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Figure S1	Basic properties of SPCE.
Figure S2	The temperature change of the substrate and the effect of the increased temperature on the SPCE signal.
Figure S3	The SPCE response when the interval time between two pulses was extended.
Figure S4	Simulated reflectivity curves and SPCE signals of the multilayers with different thicknesses of Co layer.
Figure S5	Effect of the thickness of Au on the SPCE response.

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1. Basic properties of SPCE (1mM RhB–2% PMMA)

23 nm Au/3 nm Cr/7.5 nm Co/2 nm Cr/glass multilayer was chosen as the experimental substrate. The dye (1 mM RhB in 2% PMMA) was deposited on it by spin-coating. The basic SPCE properties of this substrate are shown in Figure S1. The SPCE intensity was strong and highly p-polarized with a good angular distribution at around 65° (Figure S1).

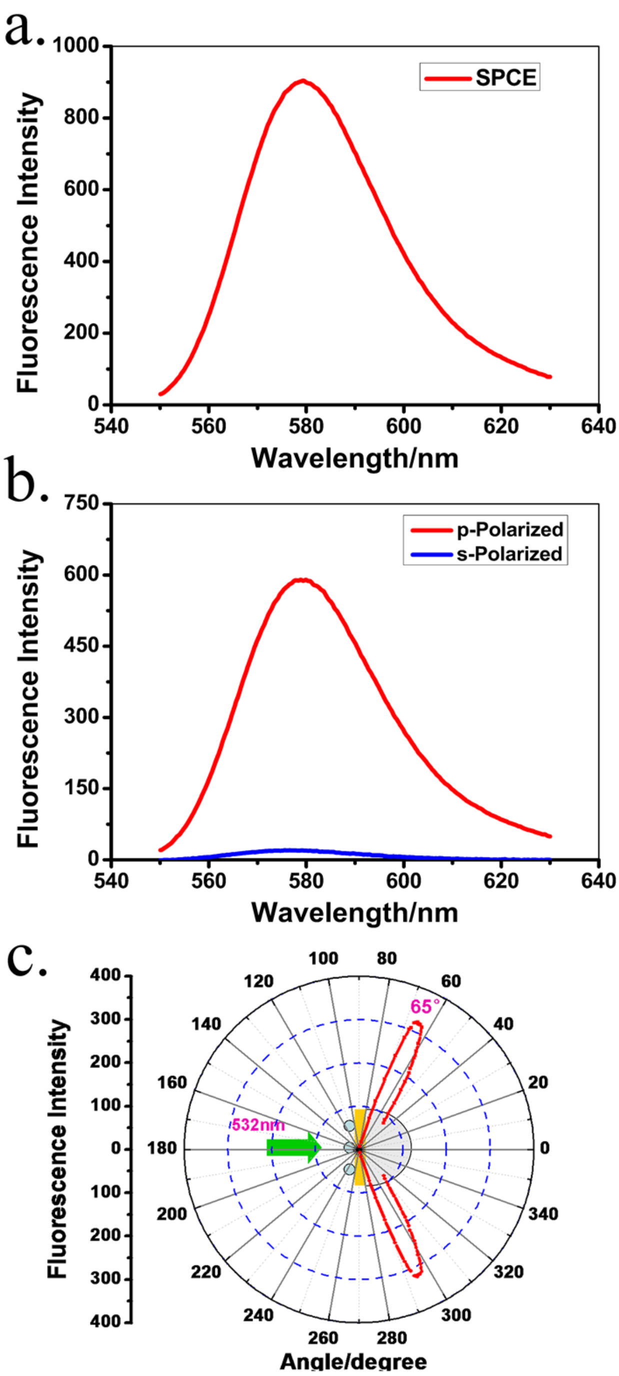

Figure S1. (a) The spectrum of SPCE of 1 mM RhB-2% PMMA on 23 nm Au/3 nm Cr/7.5 nm Co/2 nm Cr/glass multilayer substrate. (b) Polarized emission spectra of SPCE. (c) Angular distribution of SPCE. All these results were obtained without the magnetic field. Excitation wavelength was 532 nm from a laser.

2. The temperature change of the substrate and the effect of the increased temperature on the SPCE signal

The temperature change of the substrate (Figure S2a) was measured by thermo-image device. The temperature increased first, and reached the maximum temperature in about 20s and went back to the original value in about 300s. Then, the effect of the increased temperature on the SPCE of 1 mM RhB-2% PMMA deposited on 23 nm Au/3 nm Cr/7.5 nm Co/2 nm Cr/glass multilayer (Figure S2b) was tested. The SPCE signal was detected after the substrate was heated to the different temperature. The result shows that the increased temperature will decrease the SPCE signal. Therefore, the temperature cannot be the reason why the SPCE can be modulated positively.

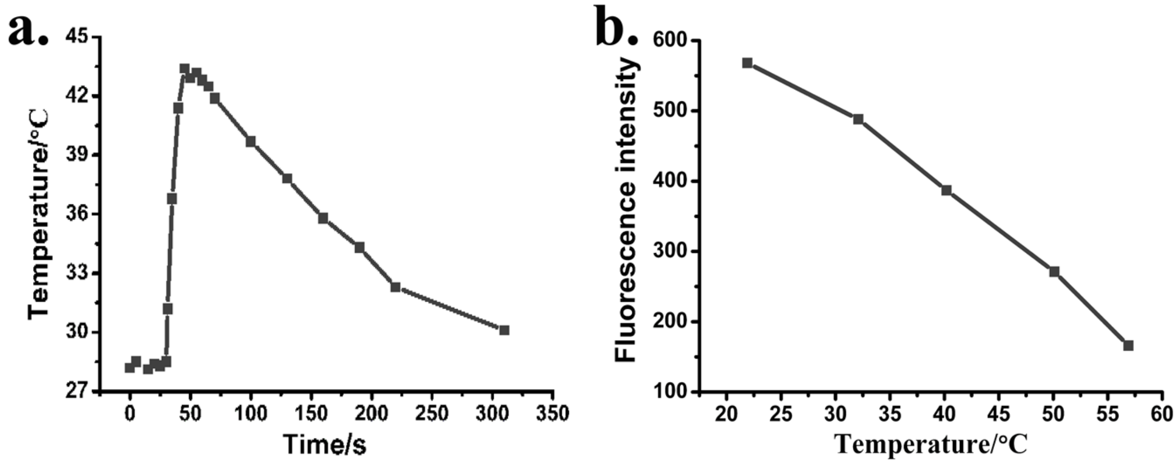

Figure S2. (a) The temperature change of the substrate after applying the pulsed magnetic field. (b) The effect of the increased temperature on the SPCE signal of 1 mM RhB-2% PMMA deposited on 23 nm Au/3 nm Cr/7.5 nm Co/2 nm Cr/glass multilayer.

3. The SPCE response when the interval time between two pulses was extended

The SPCE response of 1 mM RhB-2% PMMA deposited on 23 nm Au/3 nm Cr/7.5 nm Co/2 nm Cr/glass multilayer was measured (Figure S3). The time needed to cool the magnetic coil was about 300s (Figure S2a). When the interval time between two pulses was extended to 300 s, the effect of temperature caused by the magnetic coil became negligible, and the stable magnetic response of SPCE was obtained (Figure S3).

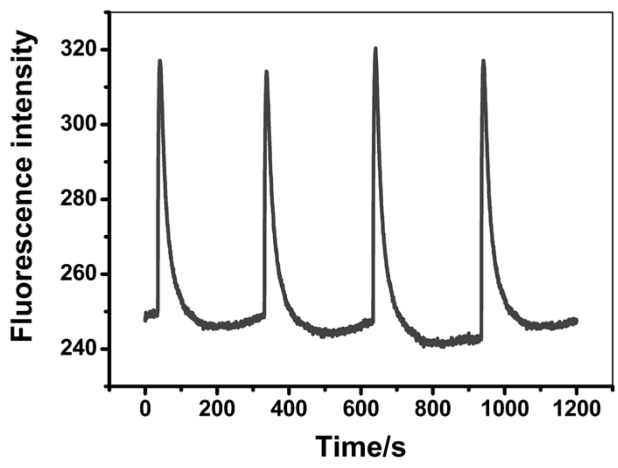

Figure S3. The response of SPCE signal of 1 mM RhB-2% PMMA on 23 nm Au/3 nm Cr/7.5 nm Co/2 nm Cr/glass to the pulsed magnetic field (1.8 T) when the interval time between two pulses was extended to 300 s.

4. Simulated reflectivity curves of 23 nm Au/3 nm Cr/x nm Co/2 nm Cr (x=0, 1, 4, 7.5, 11, 15) substrates and the SPCE signals when x=1, 4, 7.5, 15.

The validated theoretical SPR spectrums were obtained using the Fresnel equation for 23 nm Au/3 nm Cr/x nm Co/2 nm Cr (x=0, 1, 4, 7.5, 11, 15) at the emission wavelength of 580 nm in Kretschmann geometry. The calculated reflectivity when the Co layer is 7.5 nm, corresponding to the curve depicted in Figure S4a, is predicted to be minimum at SPR angle, which means that the constitute of 23 nm Au/3 nm Cr/7.5 nm Co/2 nm Cr multilayer is most suitable for the SPCE response to the magnetic field. As shown in Figure S4b, the SPCE signal was strongest when the thickness of Co is 7.5nm which fits well with the calculated results.

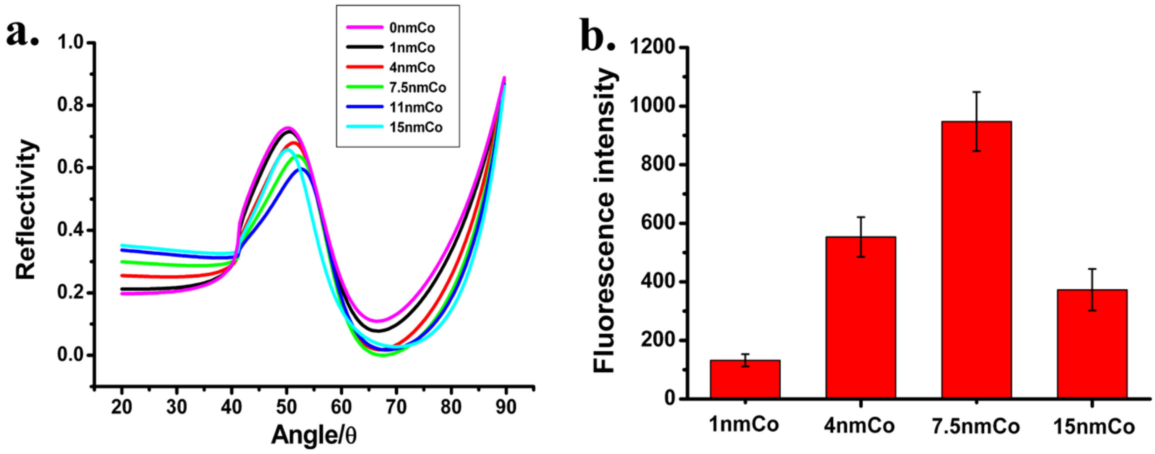

Figure S4. (a) Simulated reflectivity curves of 23 nm Au/3 nm Cr/ x nm Co/2 nm Cr (x=0, 1, 4, 7.5, 11, 15) substrates and (b) the SPCE signals when x=1, 4, 7.5, 15

5. The effect of the thickness of Au layer on the SPCE response to the magnetic field

Because the results of modulation of the magnetic field to SPCE can be affected by the properties of SPs and the thickness of Co layer, the influence of the thickness of Au layer on the SPCE response to the magnetic field was studied here by using the multilayers with different thicknesses of Au layer (y nm Au/3 nm Cr/4 nm Co/2 nm Cr (y=23，26.5，32，40)). Here, the thickness of Co layer and the trait of SPs should be constant. These multilayers were chosen as the substrates, since the change of the properties of SPs of multilayers with 4 nm Co layer and various thicknesses of Au layer was little (Figure S5a). When the thicknesses of Au layer changed from 23 to 26.5 nm, the SPCE response became weaker (Figure S5c). In this case, the difference of the properties of SPCE can be ignored. This shows that the increase of thickness of Au layer is not effective for modulation effect by the magnetic field. It may be induced by the presence of the diamagnetic Au layer which could weaken the interactions between the magnetic field and Co layer. Besides, the change of SPCE by the magnetic field was a little stronger when the thickness of Au layer changed from 26.5 to 32 nm (Figure S5c). This may be caused by the optimal properties of SPs of this combination (32 nm Au/3 nmCr/4 nmCo/2 nm Cr) which is beneficial for the modulation of SPCE by the magnetic field (Figure S5a). As shown in Figure S5b, SPCE signal of this composition (32 nm Au/3 nm Cr/4 nm Co/2 nm Cr) was the strongest, which also indicates the properties of SPs in this composition are optimum. The properties of SPs and the increase of thickness of Au layer worked together to form the worst response of SPCE to the magnetic field when the thickness of Au layer is 40 nm (Figure S5c).

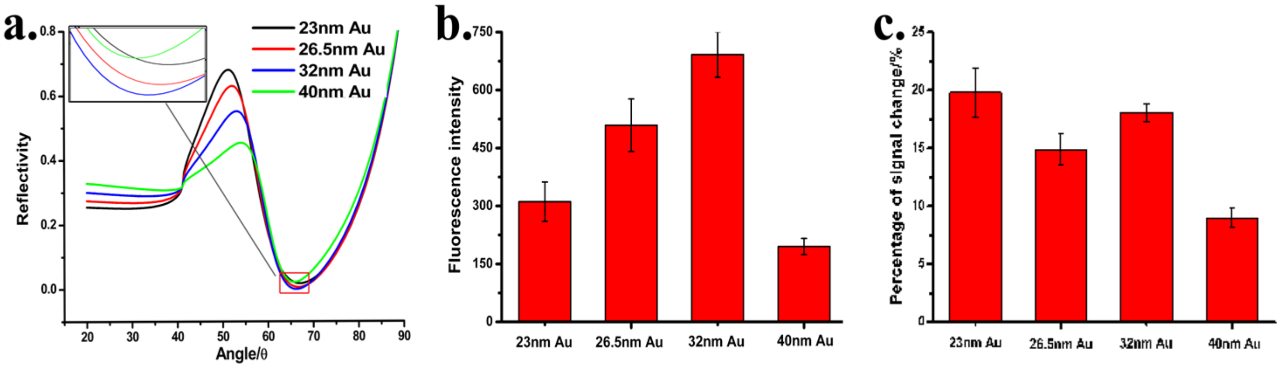

Figure S5. (a) Simulated reflectivity curves and (b) SPCE signal of the multilayers with different thicknesses of Au layer (1 mM RhB-2% PMMA on y nmAu/3 nm Cr/4 nm Co/2 nm Cr (y=23, 26.5, 32, 40)). The inset is the magnified image of the area of minimum value in the calculated SPR curve. (c) Percentage change in the SPCE signal caused by the pulsed magnetic field (1.8 T). The percentage change is defined as $100(I_{MF}-I_0)/I_0$ (I_{MF} is the maximum intensity of SPCE when the pulsed magnetic field is applied, and I_0 is the normal SPCE intensity without magnetic field).