Co/Pd-based synthetic antiferromagnetic thin films on Au/resist underlayers: towards biomedical applications

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Supporting Information

Figure S1

The experimental XRR curves (open dots) of $[Co/Pd]_4$/Ru(0.4 nm)/$[Co/Pd]_4$ samples deposited on Au/resist and SiO_x/Si are reported in Figure S1 with superimposed the results of the software simulation (color continuous curve). Thickness (t), roughness (σ) and density (ρ) values of each layer as estimated by the Leptos software package for the XRR data fitting are reported in Table S1 and Table S2 for the Au/resist and SiO_x/Si, respectively.
It is worth to note that in the physical theory for XRR curve interpretation, interface roughness (σ) is the mean-squared amplitude density fluctuations at the interface with respect to a reference level. Therefore, very small roughness values ($\sigma < 0.01$ nm) are typical of flat interfaces, while $\sigma > 1$ nm is peculiar for rough interfaces.
In the investigated multilayer, the Pd/Co periodic layers deposited on SiO_x/Si have flat interfaces, that tend to become rougher in the sample deposited on Au/resist. This latter effect can be ascribed to the rough Au layer ($\sigma = 1.25$ nm) in the Au/resist sample that influences the interface roughness of all overlying layers.
The general trend of higher interface roughness of the Pd/Co periodic layers in the Au/resist sample is clearly evident from comparison of Table S1 and Table S2.

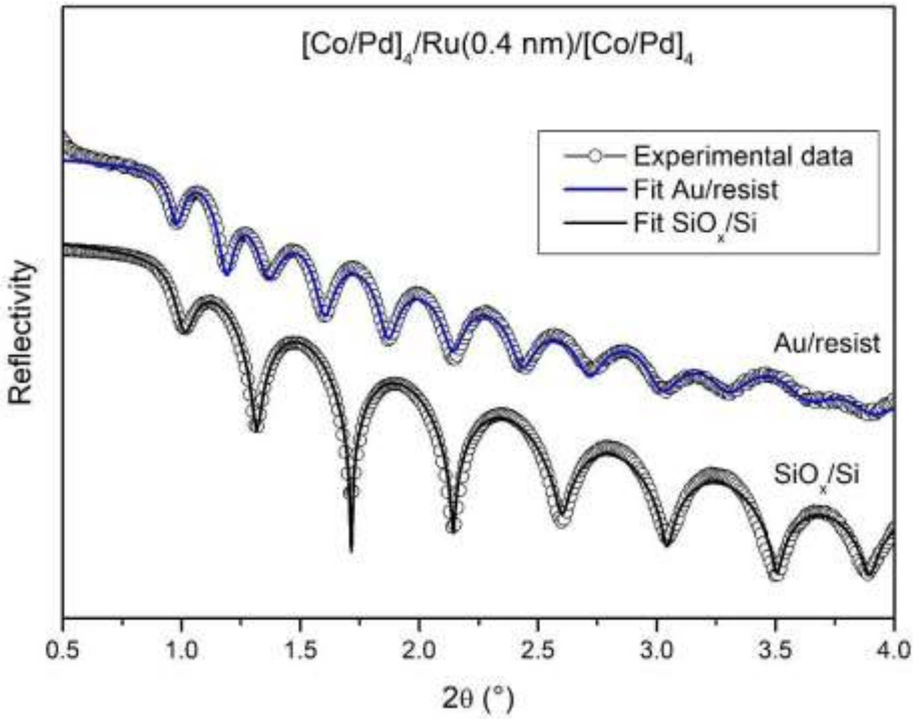

Figure S1. XRR experimental data (open dots) and best fitting (continuous line) for Co/Pd]$_4$/Ru(0.4 nm)/[Co/Pd]$_4$ samples deposited on Au/resist and SiO_x/Si.

Table S1. Software simulation results of the XRR curve fitting of the Au/resist sample. *N* is the layer number starting from the top surface, *R* is the layer repetition, SUB is the substrate, while *t*, *σ* and *ρ* are the software estimated values of thickness, roughness and density, respectively.

N	R	Material	t ± 3% (nm)	σ ± 10% (nm)	ρ ±5% (g/cm^3)
1	1	Pd	2.50	0.17	13.2
2	4	Pd	0.97	1.00	11.7
3	4	Co	0.40	0.94	10.7
4	1	Ru	0.50	0.04	12.8
5	4	Co	0.37	0.34	7.6
6	4	Pd	0.91	0.35	11.7
7	1	Pd	2.46	0.76	11.2
8	1	Ta	2.72	0.98	16.7
9	1	Au	9.01	1.25	18.6
10	1	Resist	31.2	0.24	0.86
11	1	SiO_2	117	0.67	2.43
SUB	1	Si	0.00	1.52	2.33

Table S2. Software simulation results of the XRR curve fitting of the SiO_x/Si sample. *N* is the layer number starting from the top surface, *R* is the layer repetition, SUB is the substrate, while *t*, *σ* and *ρ* are the software estimated values of thickness, roughness and density, respectively.

N	R	Material	t ± 3% (nm)	σ ± 10% (nm)	ρ ±5% (g/cm3)
1	1	Pd	2.25	0.44	11.9
2	4	Pd	0.92	0.006	11.5
3	4	Co	0.40	0.057	10.2
4	1	Ru	0.40	0.001	11.3
5	4	Co	0.48	0.004	10.4
6	4	Pd	0.93	0.090	11.8
7	1	Pd	2.09	0.005	12.4
8	1	Ta	2.74	0.42	17.9
9	1	SiO_2	106	0.33	2.14
SUB	1	Si	0.00	2.11	2.33

Figure S2

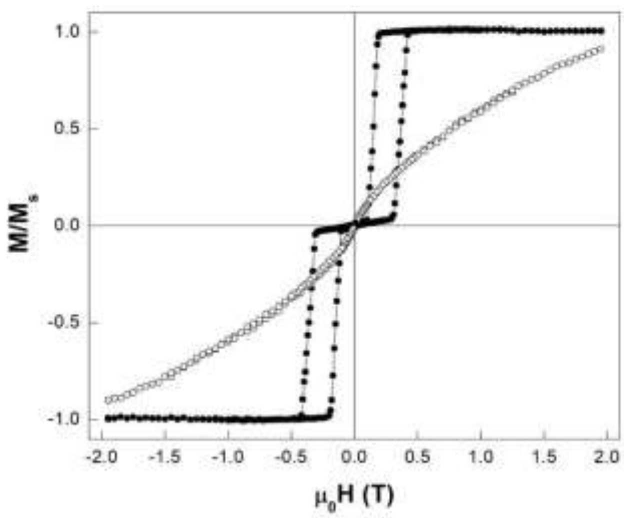

Figure S2. Room temperature in-plane and out-of-plane of-plane field-dependent magnetization loops (M/M_s vs *H*) of the {[Co/Pd]$_4$/Ru(0.4 nm)/[Co/Pd]$_4$}$_5$ (*M* = 5) film.

Figure S3

The cure procedure of the negative resist used as a mask (prebake and post-bake processes), has affected the sacrificial resist layer introducing surface ripples and cracks.

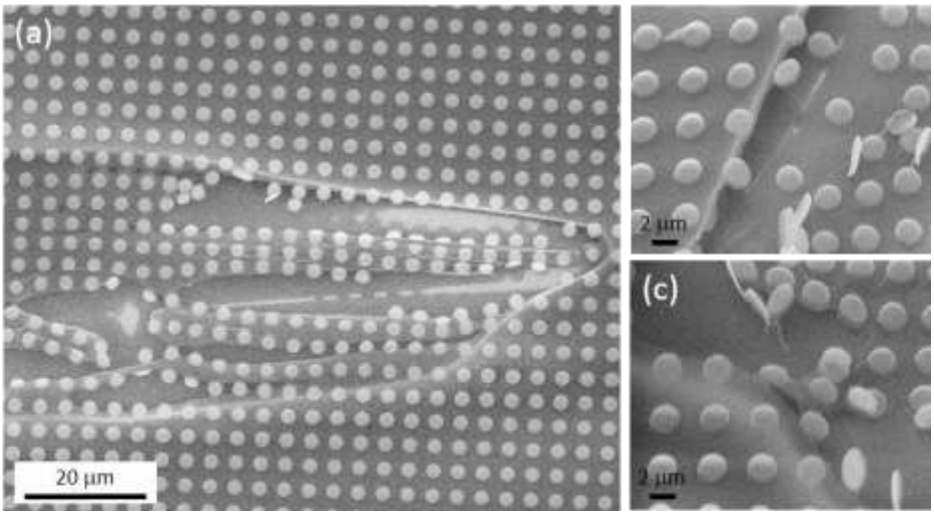

Figure S3. SEM images of the patterned microdisk array, showing the resist sacrificial layer defects induced by the curing of the e-beam negative resist.