Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information for

Magnetic Field Coupling Microfluidic Synthesis of Diluted Magnetic Semiconductor Quantum Dots: the Case of Co doping ZnSe Quantum Dots

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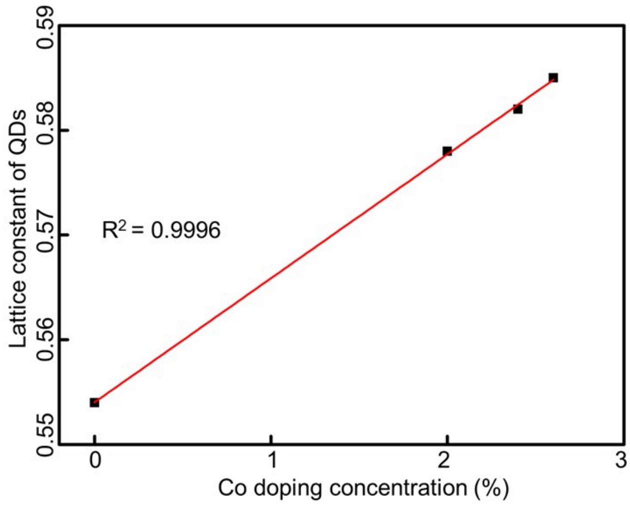

Fig. S1. The linear relationship of the Co doping concentration and lattice constant.

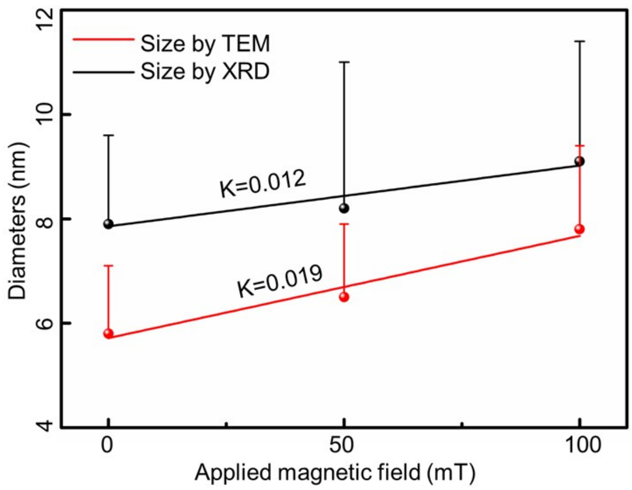

Fig. S2. The relationship between the magnetic field and the particle size.

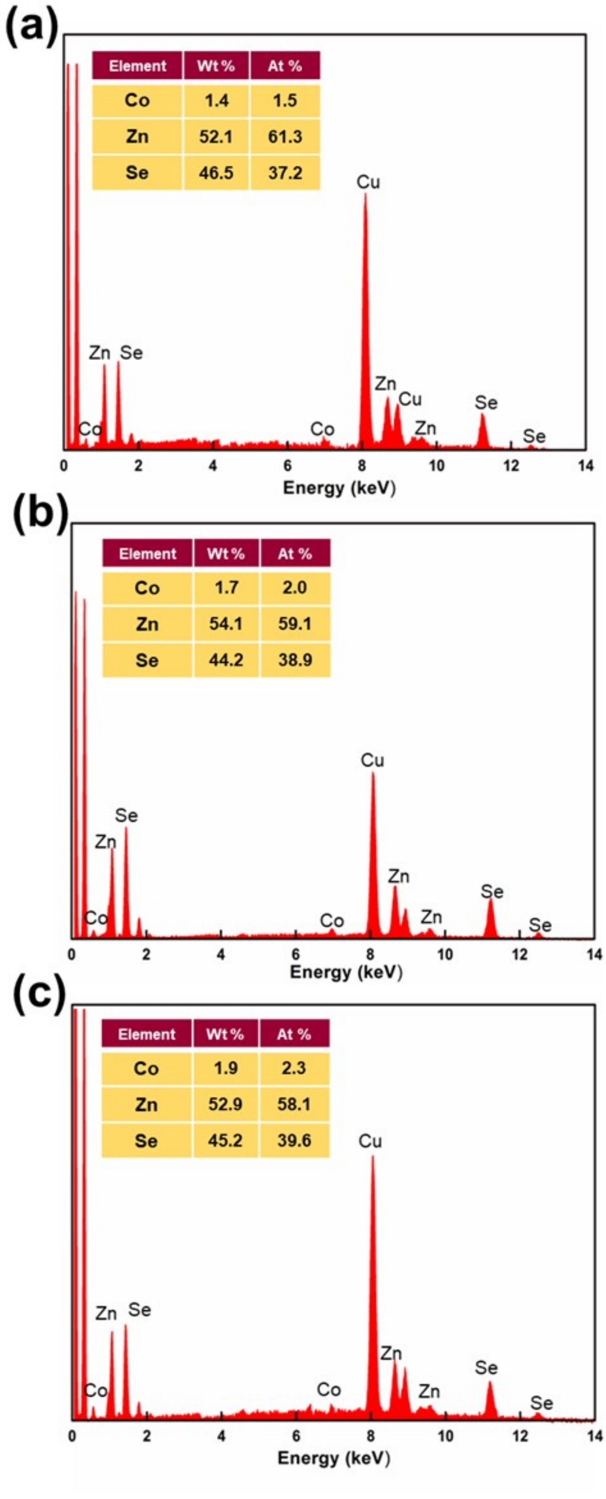

Fig. S3. EDS spectra of the ZnCoSe QDs synthesized at (a) 0 mT, (b) 50 mT, and (c) 100 mT.

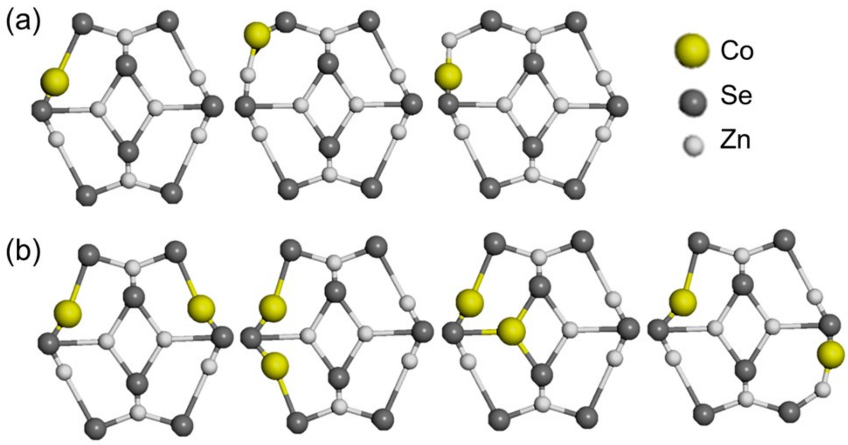

Fig. S4. Simulated schematic diagram of the Co single doping (a) and double doping (b) into ZnSe.

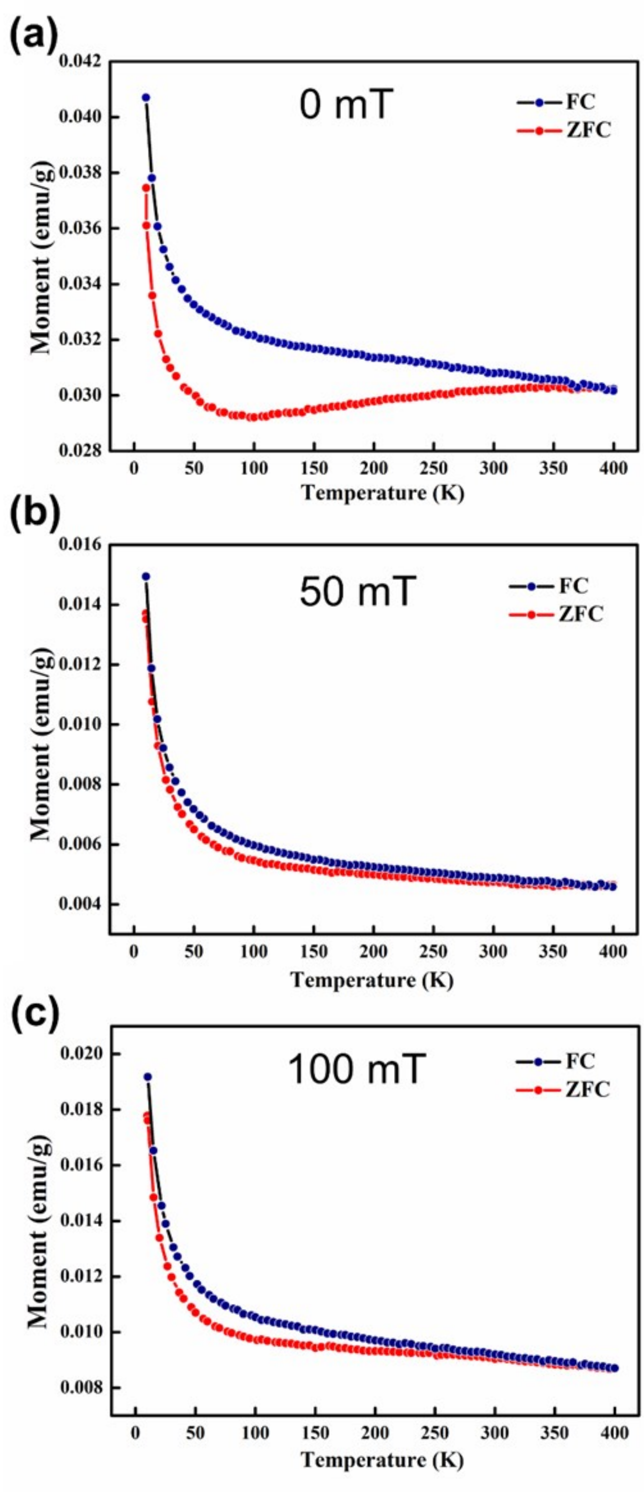

Fig. S5. The ZFC-FC curves of the ZnCoSe QDs synthesized at (a) 0 mT, (b) 50 mT, and (c) 100 mT.

Table S1

Systematic analysis of randomly selected lots of particles from TEM

Sample	Number	Mean	Standard deviation	Minimum	Median	Maximum
ZnSe	100	4.9	1.4	2.2	4.9	9.3
ZnCoSe 0 mT	100	5.8	1.3	2.4	5.6	9.5
ZnCoSe 50 mT	100	6.5	1.4	2.5	6.3	9.9
ZnCoSe 100 mT	100	7.6	1.6	2.7	7.0	10.1

Table S2

ICP, EDS, and XPS methods used to test the ratio of Co: Zn in the ZnCoSe QDs synthesized at 0 mT, 50 mT, and 100 mT

	Element	ZnCoSe 0 mT	Co:Zn	ZnCoSe 50 mT	Co:Zn	ZnCoSe 100 mT	Co:Zn
EDS	Zn	Wt 52.1% At 61.3%	Wt 2.7:100 At 2.4:100	Wt 54.1% At 59.1%	Wt 3.1:100 At 3.4:100	Wt 52.9% At 58.1%	Wt 3.6:100 At 4.0:100
	Se	Wt 46.5% At 37.2%		Wt 44.2% At 38.9%		Wt 45.2% At 39.6%	
	Co	Wt 1.4% At 1.5%		Wt 1.7% At 2.0%		Wt 1.9% At 2.3%	
ICP	Zn	28.1%	2.1:100	23.9%	2.5:100	23.9%	2.7:100
	Se	28.6%		20.9%		24.5%	
	Co	0.6%		0.6%		0.7%	
	Organics	42.7%		54.6%		51.0%	
XPS	Zn	Wt 16.5% At 5.1%	Wt 2.0:100 At 2.2:100	Wt 12.4% At 3.5%	Wt 2.3:100 At 2.6:100	Wt 15.2% At 4.5%	Wt 2.5:100 At 2.7:100
	Se	Wt 26.2% At 6.7%		Wt 23.0% At 5.3%		Wt 24.2% At 5.9%	
	Co	Wt 0.33% At 0.11%		Wt 0.29% At 0.09%		Wt 0.38% At 0.12%	
	C	Wt 50.6% At 80.8%		Wt 56.4% At 81.9%		Wt 53.8% At 82.2%	
	O	Wt 6.4% At 7.3%		Wt 7.9% At 9.2%		Wt 6.4% At 7.3%	

Table S3

Band gap of the ZnSe QDs and ZnCoSe QDs synthesized at 0 mT, 50 mT, and 100 mT calculated using the effective mass approximation theory equation

Sample	Magnetic field	Average sizes by TEM (nm)	Band gap (eV)
ZnSe	0 mT	4.8 ± 0.7	3.06
ZnCoSe	0 mT	5.8 ± 0.7	2.93
ZnCoSe	50 mT	6.5 ± 0.7	2.86
ZnCoSe	100 mT	7.6 ± 0.7	2.81

The flow and Navier-Stokes fluid mechanics equations

In this article are expressed as:

$$\nabla \cdot \vec{u} = 0$$

$$\rho \frac{\partial \vec{u}}{\partial t} + \rho(\vec{u} \cdot \nabla)\vec{u} = \vec{F} - \nabla \cdot P + \eta \nabla^2 \vec{u} \tag{1}$$

where $\vec{u}$ is the fluid's velocity vector, ρ is the fluid's density, t is the time, P is the pressure, η is the fluid's dynamic viscosity, $\nabla \cdot P$ is the force caused by the pressure gradient, $\eta \nabla^2 \vec{u}$ is the friction generated by the viscosity, and $\vec{F}$ is the external force acting on the fluid. In the three samples at 0 mT, 50 mT, and 100 mT, only $\vec{F}$ was different. For the force that the samples were subjected to in the microsomal channel, there were generally magnetization forces caused by magnetic field gradients, Lorentz forces, movement-induced viscous drag, self-gravity, and buoyancy, which were different in the three samples and played an important role in the magnetization force caused by the magnetic field gradient and Lorentz force. In our system, the relationship between the force on the fluid and the applied magnetic field is illustrated by the following equations:

$$\vec{F} = \frac{1}{2}\nabla\left[H^2 \rho \left(\frac{\partial \mu}{\partial \rho}\right)_T\right] - \frac{1}{2}H^2 \nabla \mu + \mu[\vec{J} \times \vec{H}] \tag{2}$$

The ferromagnetism substance is expressed as：

$$\vec{F} = \frac{1}{2}\mu \rho \chi_g \nabla H^2 + \mu[\vec{J} \times \vec{H}] = \vec{F_m} + \vec{F_L} \tag{3}$$