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Electronic Supplementary Information

A New Two-Dimensional Layered Germanate with In-situ Embedded Carbon Dots for Optical Temperature Sensing

Jiancong Liu,[a] Xiaoyan Ren,[b] Yan Yan,[a] Ning Wang,[a] Shuang Wang,[a] Hongyue Zhang,[a] Jiyang Li[a] and Jihong Yu[a,c]

a State Key Laboratory of Inorganic Synthesis and Preparative Chemistry, Jilin University, Qianjin Street 2699, Changchun 130012, China.

b State Key Laboratory of Electroanalytical Chemistry, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Changchun 130022, China

c International Center of Future Science, Jilin University, Qianjin Street 2699, Changchun 130012, China.

E-mail: jihong@jlu.edu.cn; lijiyang@jlu.edu.cn

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Table S1. Crystal data and structure refinement for JLG-16.

Empirical formula	$C_{24}H_{100}F_{10}Ge_{28}N_{18}O_{62}$
Formula weight	3855.50
Temperature	293(2) K
Wavelength	0.71073 Å
Crystal system, space group	Monoclinic, *C*2/*c*
Unit cell dimensions	a = 38.2008(15) Å α = 90°
	b = 8.8262(4) Å β = 108.5470(10)°
	c = 31.1789(13) Å γ = 90°
Volume	9966.5(7) $Å^3$
Z, Calculated density	4, 2.503 mg/m^3
Absorption coefficient	8.420 mm^{-1}
F(000)	7005
Crystal size	0.21 × 0.20 × 0.18 mm
Theta range for data collection	1.12 to 25.09°
Limiting indices	$-45 \leq h \leq 45$, $-8 \leq k \leq 10$, $-37 \leq l \leq 36$
Reflections collected / unique	31117 / 8845 [R_{int} = 0.0439]
Completeness to theta = 25.09	99.5%
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	0.3125 and 0.2708
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	8845 / 0 / 654
Goodness-of-fit on F^2	1.203
Final R indices [I> 2σ (I)]^a	R_1 = 0.0635, wR_2 = 0.1527
R indices (all data)	R_1 = 0.0740, wR_2 = 0.1567
Largest diff. peak and hole	1.783 and -1.243 e. $Å^{-3}$

^{a} $R_1=\Sigma(\Delta F/\Sigma(Fo))$; $wR_2=(\Sigma[w(F_o^2-F_c^2)])/\ \Sigma[w(F_o^2)^2]^{1/2}$, $w=1/[\sigma^2(F_o^2)+(0.0193P)^2+873.8065P]$

where $P=(Fo^2+2Fc^2)/3$

Table S2. Atomic coordinates (×10⁴) and equivalent isotropic displacement parameters (Å²×10³) for JLG-16. *U*(*eq*) is defined as one third of the trace of the orthogonalized U_{ij} tensor.

	x	*y*	*z*	*U*(*eq*)
Ge(1)	9124(1)	7921(1)	11203(1)	12(1)
Ge(2)	8953(1)	4136(1)	6918(1)	12(1)
Ge(3)	8547(1)	6139(1)	6176(1)	13(1)
Ge(4)	7937(1)	3865(1)	8613(1)	16(1)
Ge(5)	8409(1)	5956(1)	9361(1)	13(1)
Ge(6)	8656(1)	3777(1)	7798(1)	12(1)
Ge(7)	9179(1)	1641(1)	11299(1)	12(1)
Ge(8)	8533(1)	7999(1)	8644(1)	13(1)
Ge(9)	8901(1)	4836(1)	8804(1)	11(1)
Ge(10)	8043(1)	5843(1)	7929(1)	16(1)
Ge(11)	8662(1)	5926(1)	10445(1)	13(1)
Ge(12)	9416(1)	4766(1)	11054(1)	11(1)
Ge(13)	9623(1)	6278(1)	7046(1)	13(1)
Ge(14)	8543(1)	1720(1)	8533(1)	13(1)
F(1)	7698(1)	6613(5)	7446(1)	33(1)
F(2)	9399(1)	4853(4)	9090(1)	22(1)
F(3)	9790(1)	4753(4)	10809(1)	20(1)
F(4)	8084(1)	6824(5)	6108(1)	25(1)
F(5)	7509(1)	3121(5)	8633(2)	37(1)
O(1)	8822(1)	3262(5)	7366(1)	18(1)
O(2)	8029(1)	4769(5)	9144(2)	21(1)
O(3)	8330(1)	7690(5)	9071(1)	18(1)
O(4)	8823(1)	5134(5)	9368(1)	17(1)
O(5)	8892(1)	2763(5)	8906(1)	17(1)
O(6)	8927(1)	6929(5)	8740(1)	18(1)
O(7)	8113(1)	2016(5)	8606(2)	21(1)
O(8)	8264(1)	4934(5)	7579(1)	21(1)
O(9)	8209(1)	7699(5)	8111(1)	20(1)
O(10)	8992(1)	4534(5)	8252(1)	15(1)
O(11)	9360(1)	2682(5)	10952(1)	16(1)
O(12)	9077(1)	5101(5)	10465(1)	19(1)
O(13)	8397(1)	6426(6)	9897(1)	22(1)
O(14)	8379(1)	4718(5)	10634(1)	19(1)
O(15)	8720(1)	7635(5)	10745(1)	18(1)
O(16)	8540(1)	5157(5)	6675(1)	19(1)

O(17)	9034(1)	7646(5)	11710(1)	17(1)
O(18)	9352(1)	5085(5)	7259(1)	21(1)
O(19)	10000	6812(7)	7500	23(2)
O(20)	9773(1)	4496(5)	11628(1)	16(1)
O(21)	9405(1)	1960(5)	11873(1)	19(1)
O(22)	8706(1)	1979(5)	11186(1)	17(1)
O(23)	9480(1)	6842(5)	11143(1)	16(1)
O(24)	8506(1)	2023(5)	7962(1)	20(1)
O(25)	7707(1)	4896(6)	8110(2)	24(1)
O(26)	9258(1)	9779(5)	11175(2)	18(1)
O(27)	8363(1)	4860(5)	8491(1)	11(1)
O(28)	9031(1)	4785(5)	11327(1)	11(1)
O(29)	8680(1)	9860(5)	8673(2)	28(1)
N(1)	8057(2)	-232(8)	7321(2)	36(2)
N(2)	8026(2)	2076(8)	6696(2)	38(2)
N(3)	7764(2)	5270(7)	6663(2)	23(2)
C(1)	8309(2)	-322(10)	7029(3)	44(3)
C(2)	8149(2)	589(10)	6601(3)	41(2)
C(3)	7743(3)	2779(10)	6297(3)	46(3)
C(4)	7528(2)	3959(10)	6457(3)	41(3)
N(4)	9622(2)	-2496(11)	8637(3)	60(3)
N(5)	9422(6)	189(15)	8081(5)	217(9)
N(6)	9752(2)	2734(11)	8566(4)	87(4)
C(5)	9492(3)	-2503(16)	8155(4)	76(4)
C(6)	9279(4)	-1192(14)	7940(4)	89(5)
C(7)	9709(5)	1113(18)	7908(5)	146(6)
C(8)	9710(3)	2708(18)	8090(4)	89(5)
N(7)	8984(3)	2283(10)	-79(3)	79(3)
N(8)	8116(4)	140(20)	-116(6)	159(8)
N(9)	7436(4)	1155(19)	-83(10)	257(14)
C(9)	8561(5)	1740(20)	-149(5)	180(7)
C(10)	8511(5)	540(20)	-10(8)	162(9)
C(11)	7998(5)	10(20)	248(7)	154(8)
C(12)	7588(4)	-61(18)	132(7)	123(7)
O(1W)	9544(3)	6489(17)	9953(3)	163(5)
O(2W)	9991(4)	5898(18)	10014(4)	68(5)
O(3W)	9893(4)	9750(30)	5756(7)	170(10)
O(4W)	9548(5)	9590(30)	9956(6)	106(7)

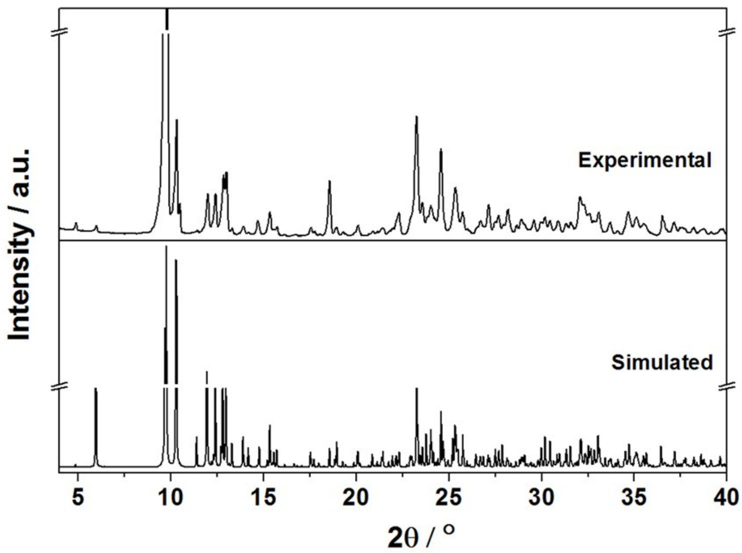

Fig. S1. The experimental powder XRD pattern of CDs@JLG-16 and simulated XRD pattern of JLG-16.

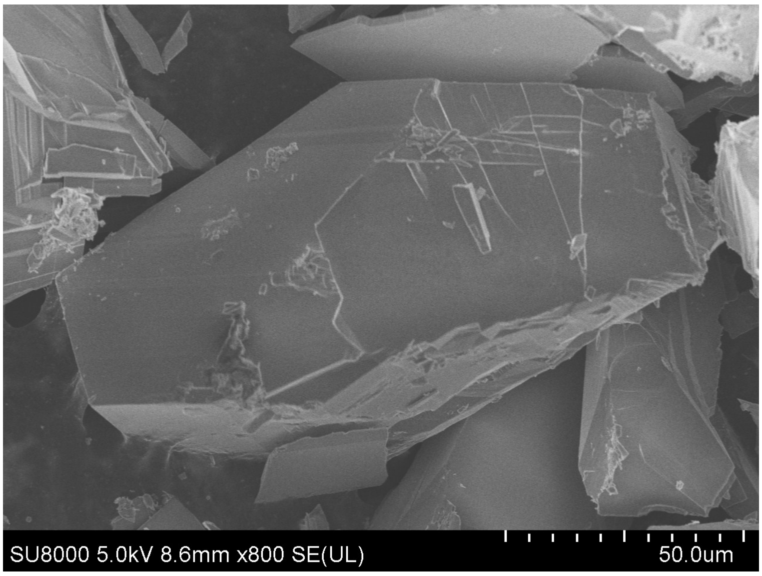

Fig. S2. Scanning electron microscopy image of CDs@JLG-16.

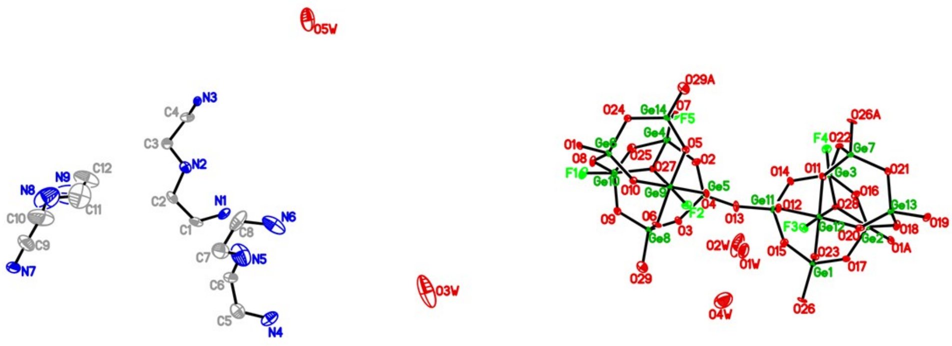

Fig. S3. Thermal ellipsoid plot (50%) for JLG-16 showing the asymmetric unit.

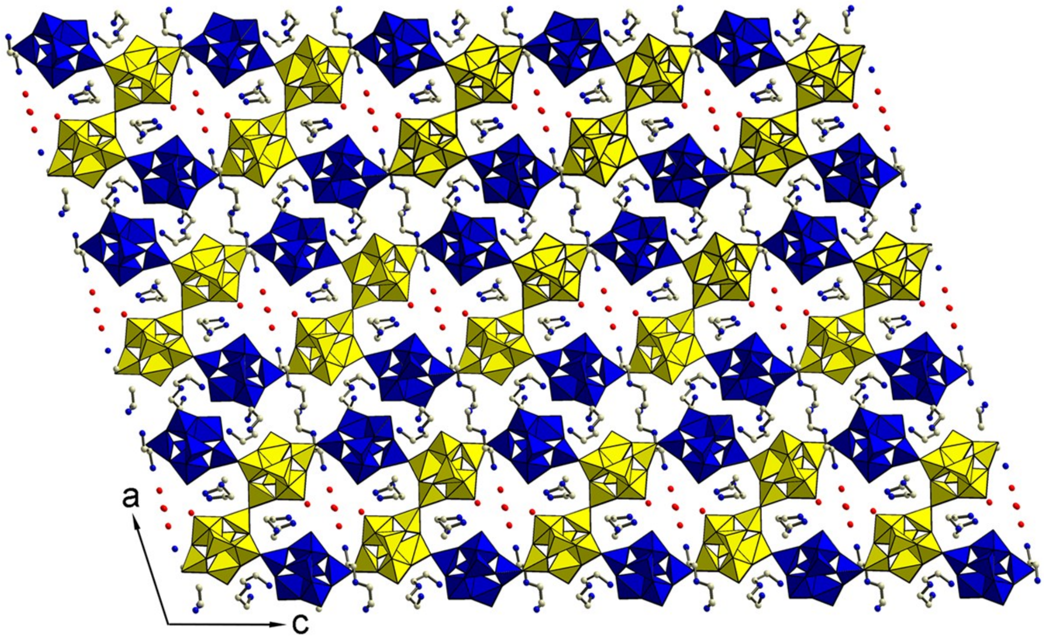

Fig. S4. The structure of JLG-16 viewed along the [010] direction with the diprotonated H_2dien^{2+} cations and H_2O molecules reside in the channels and the interlayer regions. The germanate framework constructed with Ge_7 clusters is shown with blue and yellow polyhedra. Carbon and nitrogen atoms of the diprotonated H_2dien^{2+} cations are represented in gray and blue, respectively. The water molecules are shown by red spheres for clarity.

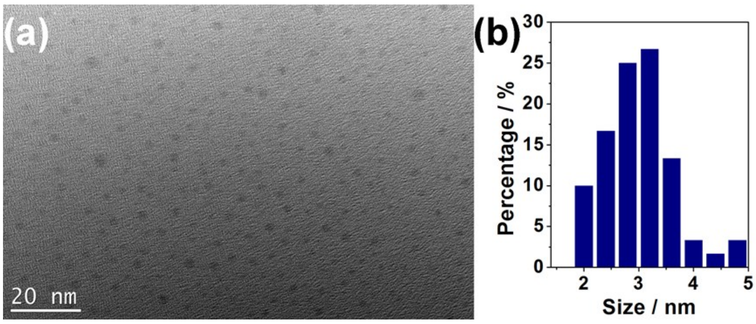

Fig. S5. (a) TEM image of CDs in the mother liquid of CDs@JLG-16. (b) The distribution of CDs particle diameters obtained by counting 60 particles.

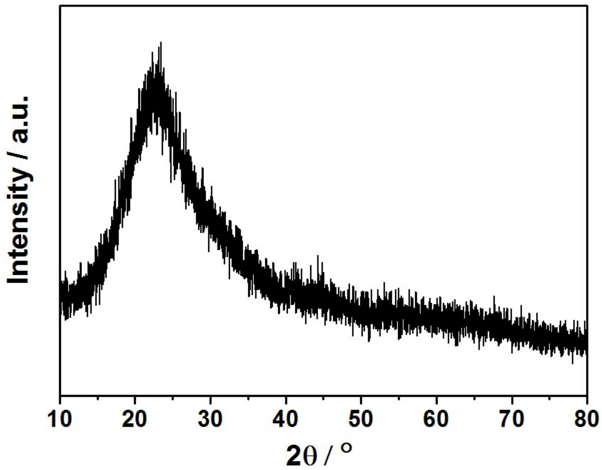

Fig. S6. XRD pattern of the CDs isolated from the mother liquid of CDs@JLG-16.

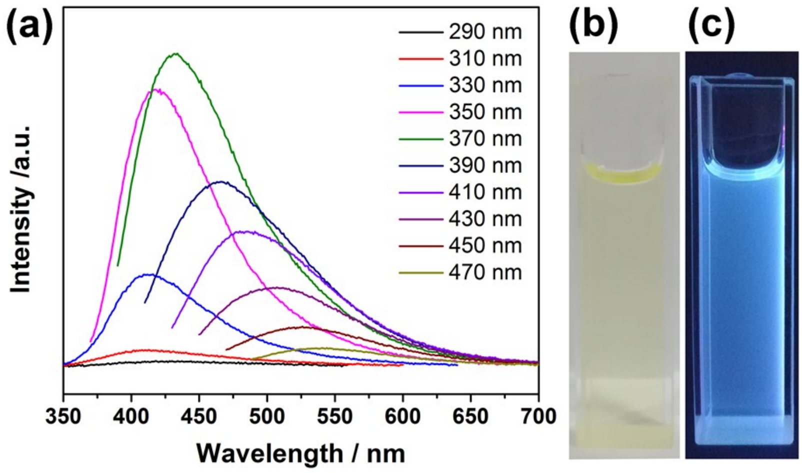

Fig. S7. (a) Excitation-dependent photoluminescence spectra of the mother liquid of CDs@JLG-16. Photographs of the mother liquid with sunlight (b) and UV excited (λ_{ex} = 365 nm) (c).

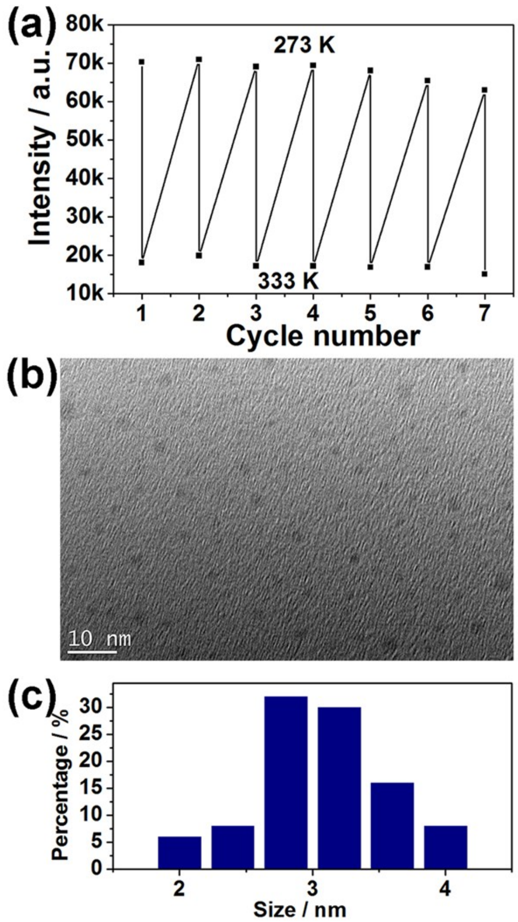

Fig. S8. (a) Reversible fluorescence response of CDs@JLG-16 between 273 K and 333 K for 7 times. (b) TEM image of CDs isolated from CDs@JLG-16 after 7 runs. (c) The size distribution of CDs obtained by counting 50 particles.