Electronic supplementary information for:

Layered gadolinium hydroxides for simultaneous drug delivery and imaging

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Table S1. Elemental analysis data for the drug intercalates prepared by ion exchange. NM = not measured.

Material	Elemental analysis				Chemical formula
	C%	H%	N%	Gd:O ratio	
	Obsd (calcd)	Obsd (calcd)	Obsd (calcd)	Obsd (calcd)	
LGdH-Cl	0.35 (0.27)	1.45 (1.56)	0 (0)	NM	$[Gd_2(OH)_5]Cl_{0.8}(CO_3)_{0.1}\cdot H_2O$
LGdH-dic	19.91 (20.36)	1.94 (2.29)	2.14 (1.70)	2.52 (2.59)	$[Gd_2(OH)_5](C_{14}H_{10}Cl_2NO_2)_{0.8}Cl_{0.2}\cdot H_2O$
LGdH-ibu	22.52 (22.86)	3.63 (3.82)	0 (0)	2.30 (2.37)	$[Gd_2(OH)_5](C_{13}H_{17}O_2)_{0.9}Cl_{0.1}\cdot 1.5H_2O$
LGdH-nap	22.37 (22.05)	3.11 (3.09)	0 (0)	2.00 (2.13)	$[Gd_2(OH)_5](C_{14}H_{13}O_3)_{0.82}Cl_{0.18}\cdot 1.75H_2O$

Table S2. Elemental analysis data for the drug intercalates prepared by coprecipitation.

Material	pH	Elemental analysis				Chemical formula
		C%	H%	N%	Gd:O ratio	
		Obsd (calcd)	Obsd (calcd)	Obsd (calcd)	Obsd (calcd)	
LGdH-dic-c	12	20.35 (20.43)	3.73 (2.99)	2.41 (1.70)	2.35 (1.82)	$[Gd_2(OH)_5](C_{14}H_{10}Cl_2NO_2)_{0.9}Cl_{0.1}\cdot 4H_2O$
LGdH-ibu-c	8	37.24 (37.66)	4.76 (5.11)	0 (0)	2.20 (1.97)	$[Gd_2(OH)_5](C_{13}H_{17}O_2)(C_{13}H_{18}O_2)\cdot H_2O$
	10	36.10 (35.67)	4.63 (4.91)	0 (0)	2.61 (2.05)	$[Gd_2(OH)_5](C_{13}H_{17}O_2)(C_{13}H_{18}O_2)_{0.8}\cdot H_2O$
	12	28.94 (28.94)	4.15 (4.26)	0 (0)	1.82 (2.31)	$[Gd_2(OH)_5](C_{13}H_{17}O_2)(C_{13}H_{18}O_2)_{0.25}\cdot H_2O$
LGdH-nap-c	12	31.81 (31.29)	3.18 (3.63)	0 (0)	2.24 (1.80)	$[Gd_2(OH)_5](C_{14}H_{13}O_3)(C_{14}H_{14}O_3)_{0.4}\cdot 1.75H_2O$

Table S3. Elemental analysis data for the drug intercalates prepared by self-assembly. NM = not measured.

Material	Elemental analysis				Chemical formula
	C%	H%	N%	Gd:O ratio	
	Obsd (calcd)	Obsd (calcd)	Obsd (calcd)	Obsd (calcd)	
LGdH-dic-sa	20.08 (20.19)	2.26 (2.36)	1.84 (1.68)	NM (2.49)	$[Gd_2(OH)_5](C_{14}H_{10}Cl_2NO_2)_{0.8}\,Cl_{0.2}\cdot 1.3H_2O$
LGdH-ibu-sa	23.83 (23.46)	3.67 (4.01)	0 (0)	2.19 (2.21)	$[Gd_2(OH)_5](C_{13}H_{17}O_2)_{0.95}Cl_{0.05}\cdot 2H_2O$
LGdH-nap-sa	23.21 (23.39)	3.06 (3.10)	0 (0)	2.22 (2.15)	$[Gd_2(OH)_5](C_{14}H_{13}O_3)_{0.88}Cl_{0.12}\cdot 1.5H_2O$

Table S4. Relaxivity data for the various LGdH-drug intercalates, with controls.

Sample	[Gd] (mM)	T_1 (ms)	T_2 (ms)	r_1 ($mM^{-1}\,s^{-1}$)	r_2 ($mM^{-1}\,s^{-1}$)	r_2/r_1
Gd(DTPA)	0.9663	235	208	4.10	4.57	1.11
Gd_2O_3	1.0562	3078	2447	0.02	0.02	1.00
LGdH-dic-sa	1.0308	871	466	0.82	1.71	2.09
LGdH-dic-c (pH12)	0.9271	1052	529	0.70	1.62	2.31
LGdH-ibu-sa	1.0352	857	586	0.83	1.27	1.53
LGdH-ibu-c (pH8)	0.7429	922	400	1.05	2.84	2.70
LGdH-ibup-c (pH10)	0.8073	1041	354	0.81	3.02	3.70
LGdH-ibup-c (pH12)	0.8542	1027	377	0.78	2.65	3.40
LGdH-nap-sa	0.7841	804	573	1.20	1.73	1.44
LGdH-nap-c (pH12)	0.6486	1192	746	0.82	1.47	1.79
LGdH-dic	0.8173	747	223			
	0.4670	949	315	0.96	4.84	5.04
	0.3269	1177	503			
LGdH-ibu	0.9758	762	234			
	0.6099	790	350	0.23	3.46	15.04
	0.4880	842	377			
LGdH-nap	1.0072	693	79			
	0.5756	886	324	0.60	16.25	27.28
	0.3289	952	449			
LGdH-Cl	0.9416	774	155			
	0.6277	894	251	0.51	7.56	14.82
	0.4708	950	343			

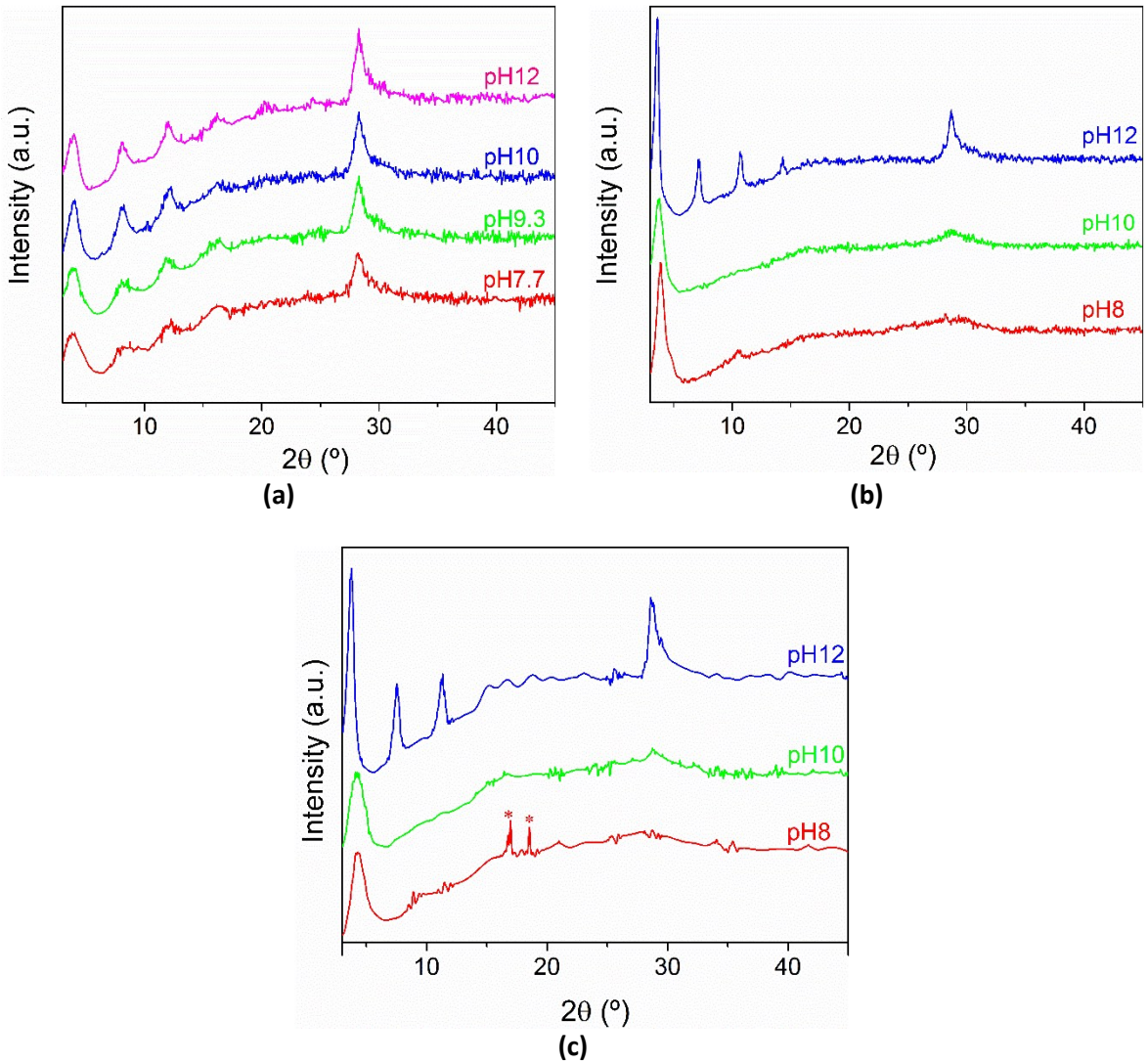
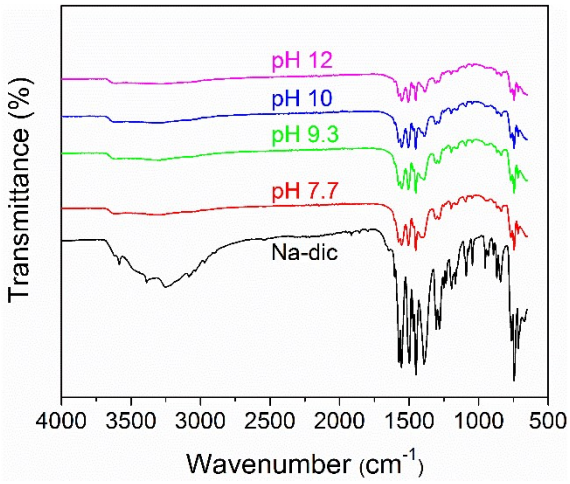
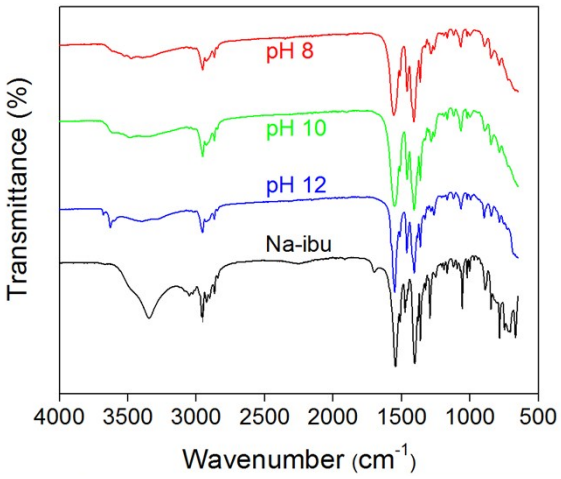


Figure S1. XRD patterns of the drug intercalates prepared by coprecipitation: (a) LGdH-dic-c; (b) LGdH-ibu-c; (c) LGdH-nap-c.



(a)



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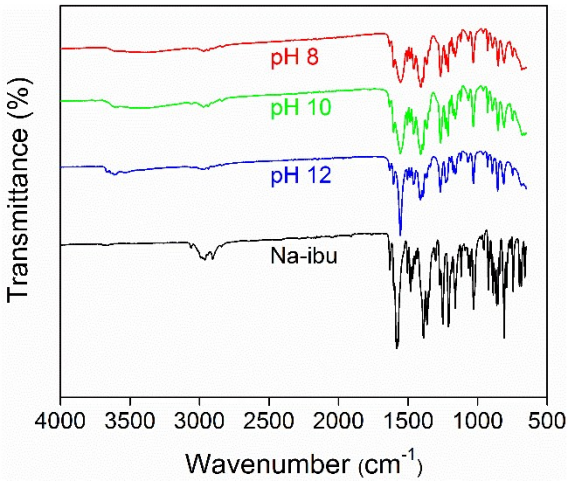
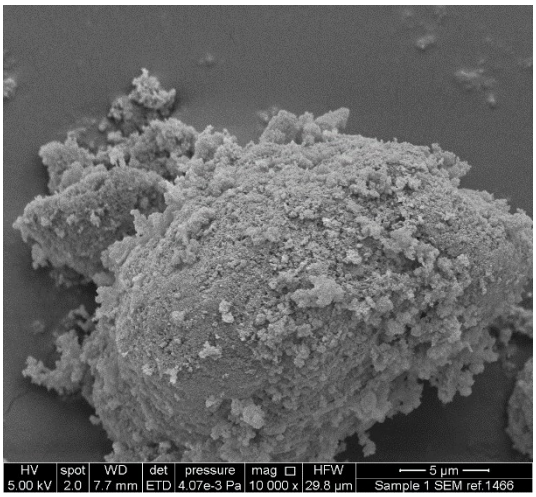
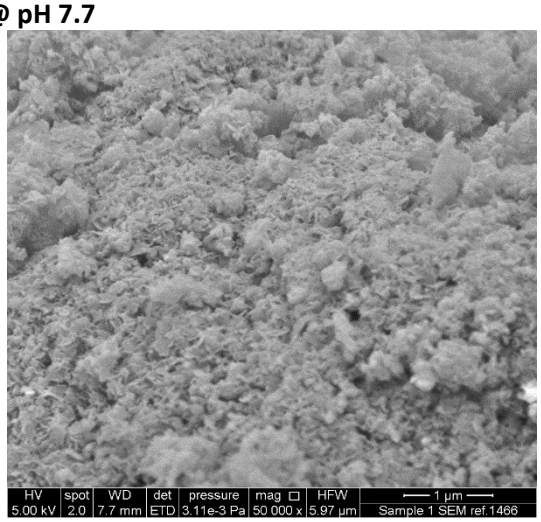


(c)

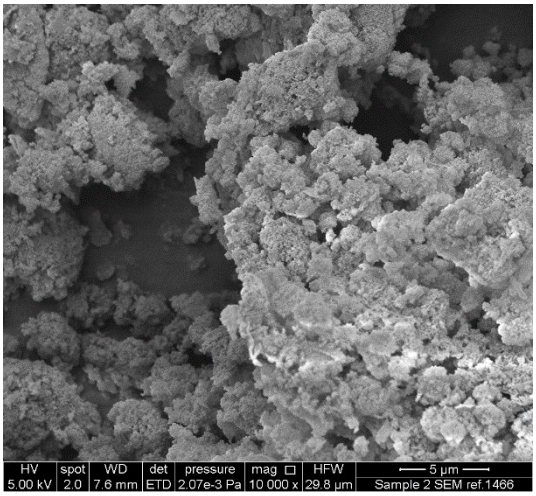
Figure S2. IR spectra of the drug intercalates prepared by coprecipitation: (a) LGdH-dic-c; (b) LGdH-ibu-c; (c) LGdH-nap-c.

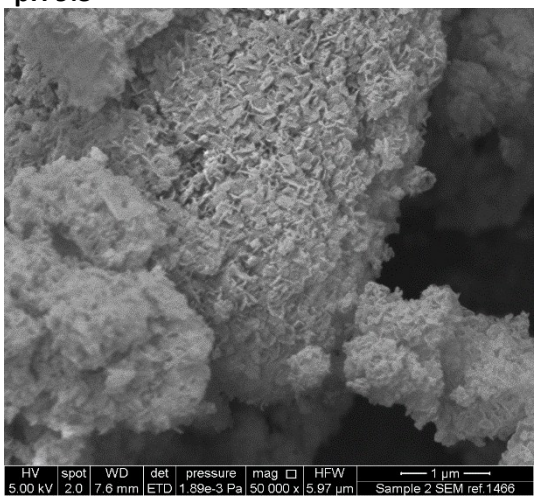
LGdH-dic-c @ pH 7.7



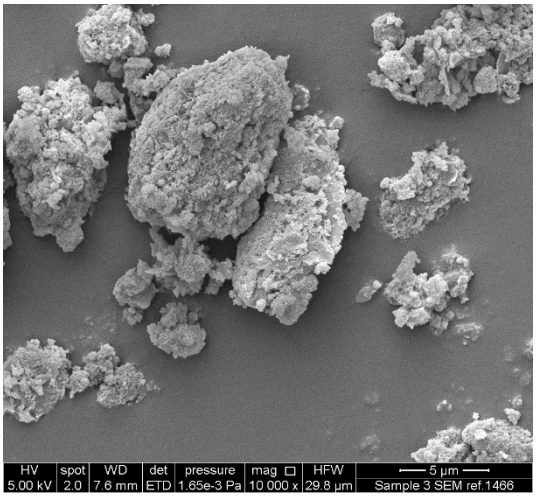


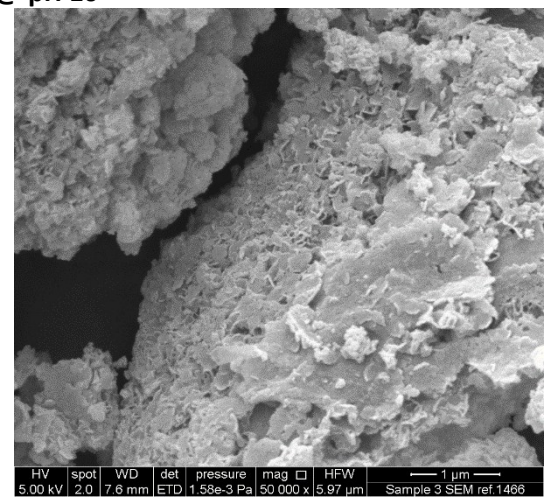
LGdH-dic-c @ pH 9.3





LGdH-dic-c @ pH 10





LGdH-dic-c @ pH 12

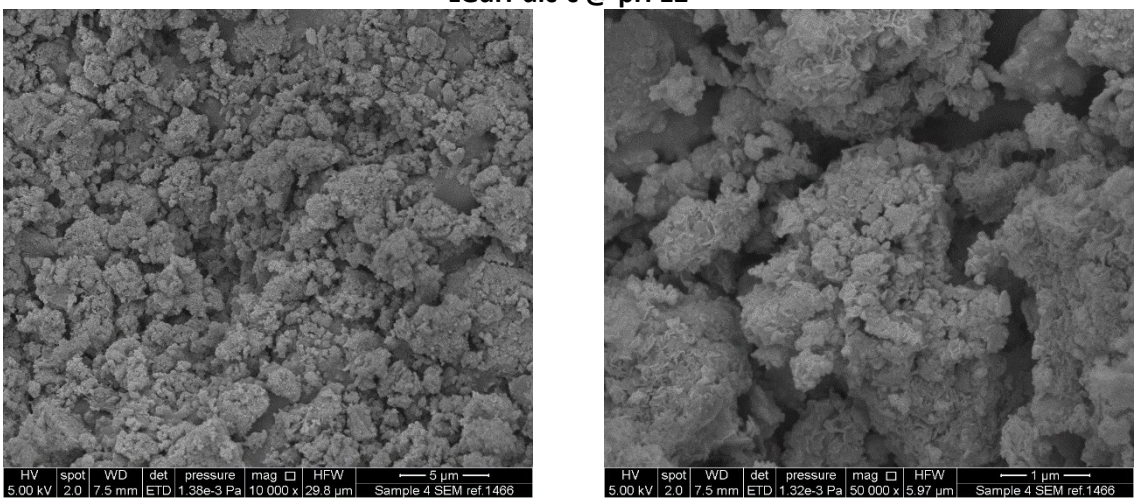
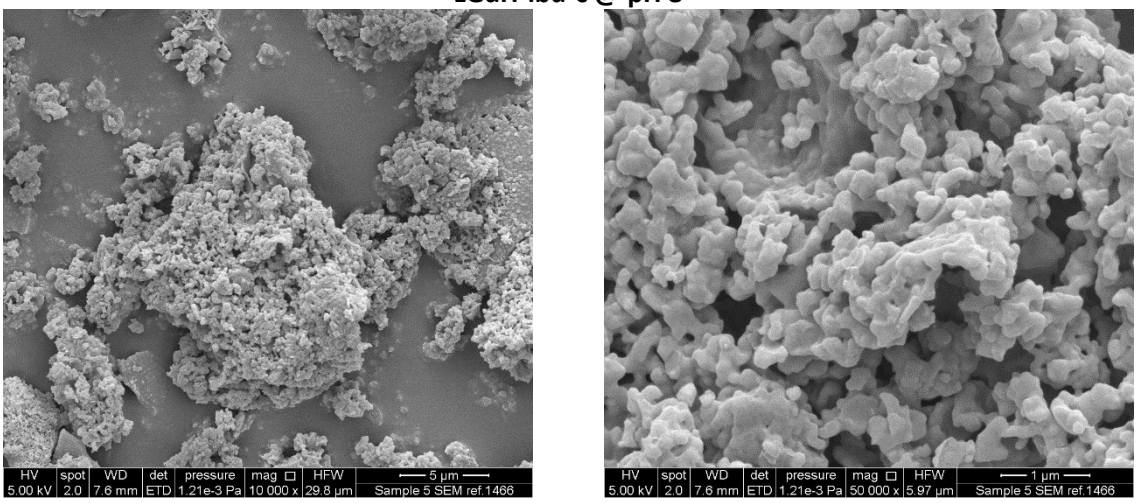
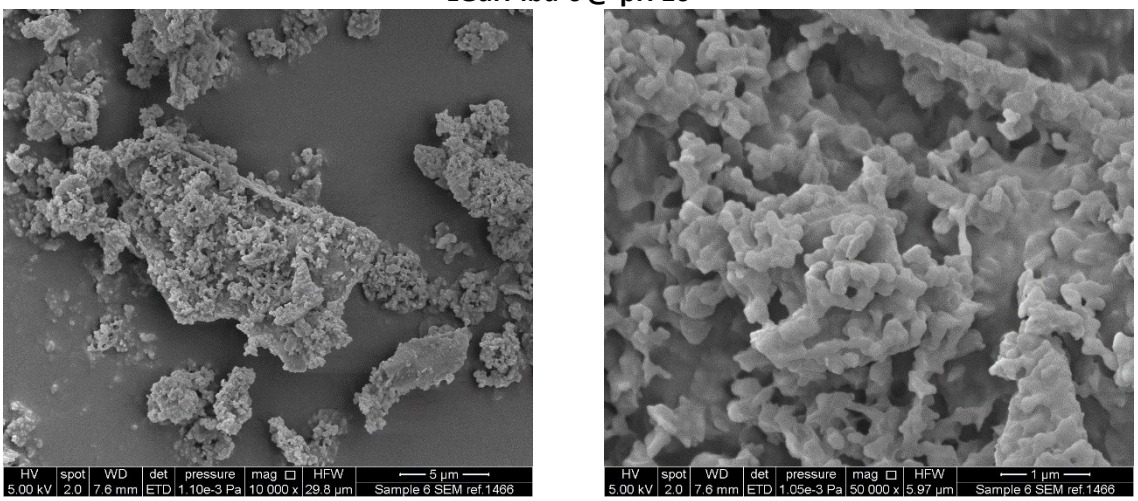


Figure S3. SEM images of the LGdH-dic-c drug intercalates, prepared by coprecipitation.

LGdH-ibu-c @ pH 8



LGdH-ibu-c @ pH 10



LGdH-ibu-c @ pH 12

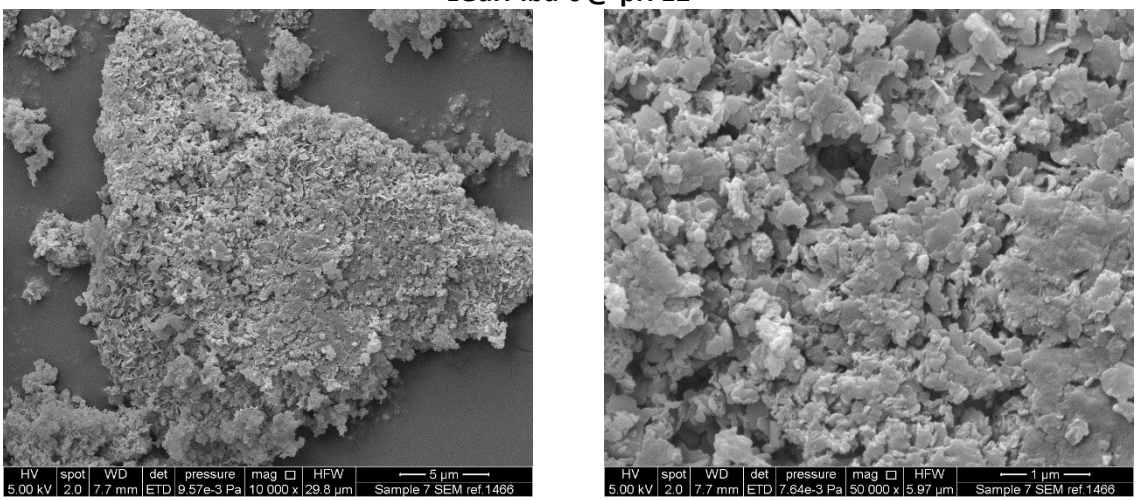
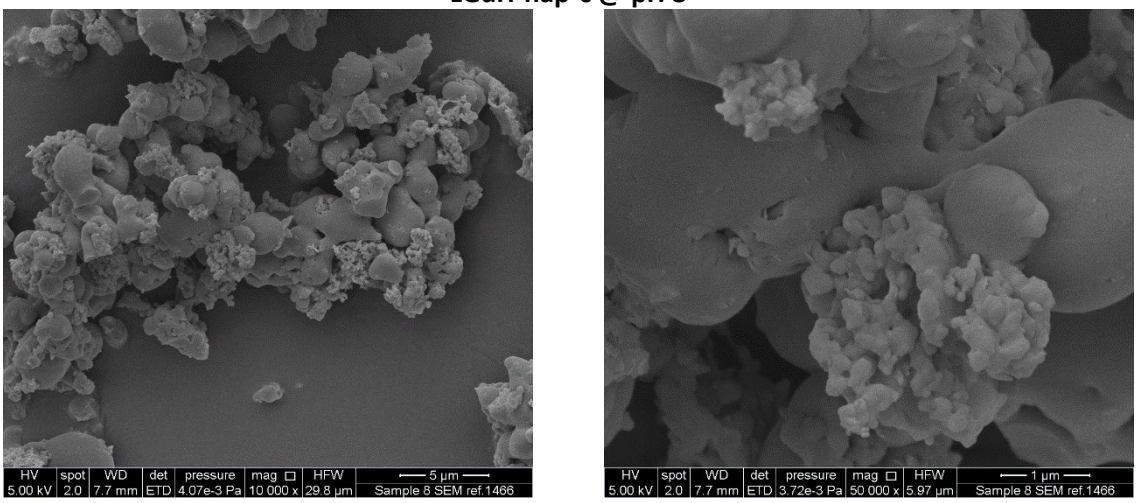
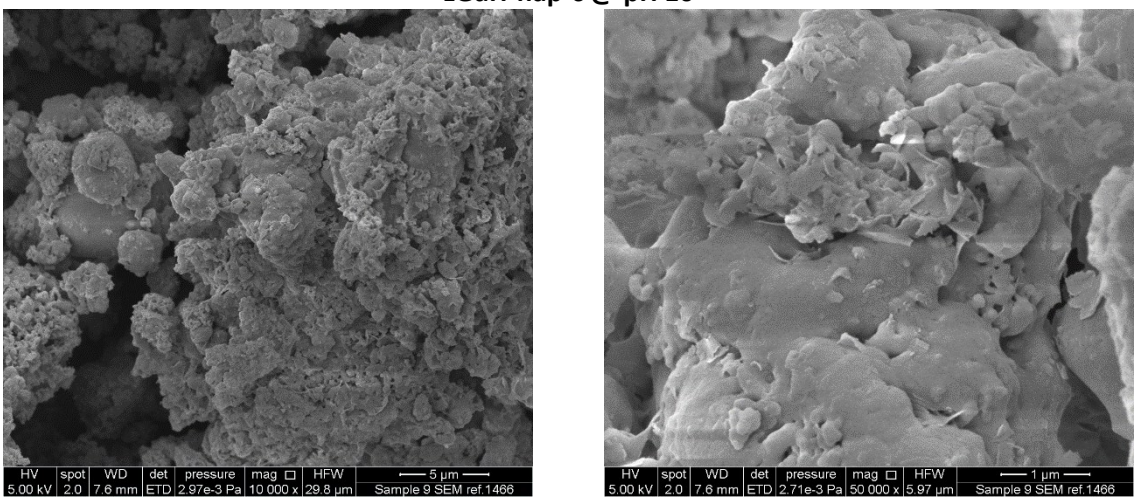


Figure S4. SEM images of the LGdH-ibu-c drug intercalates.

LGdH-nap-c @ pH 8



LGdH-nap-c @ pH 10



LGdH-nap-c @ pH 12

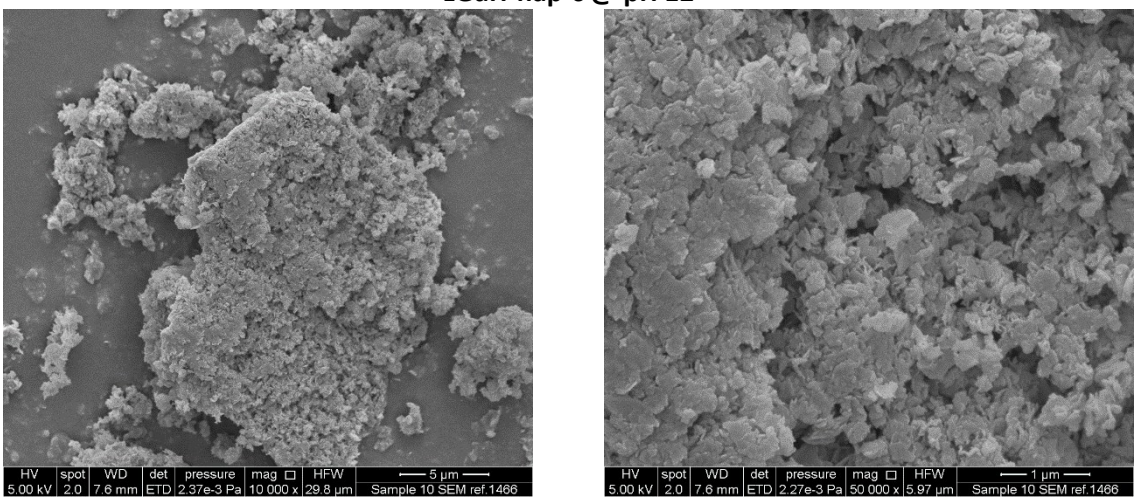


Figure S5. SEM images of the LGdH-nap-c drug intercalates.

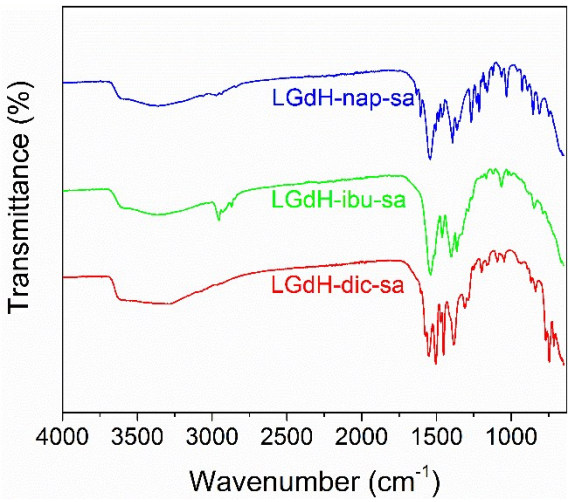
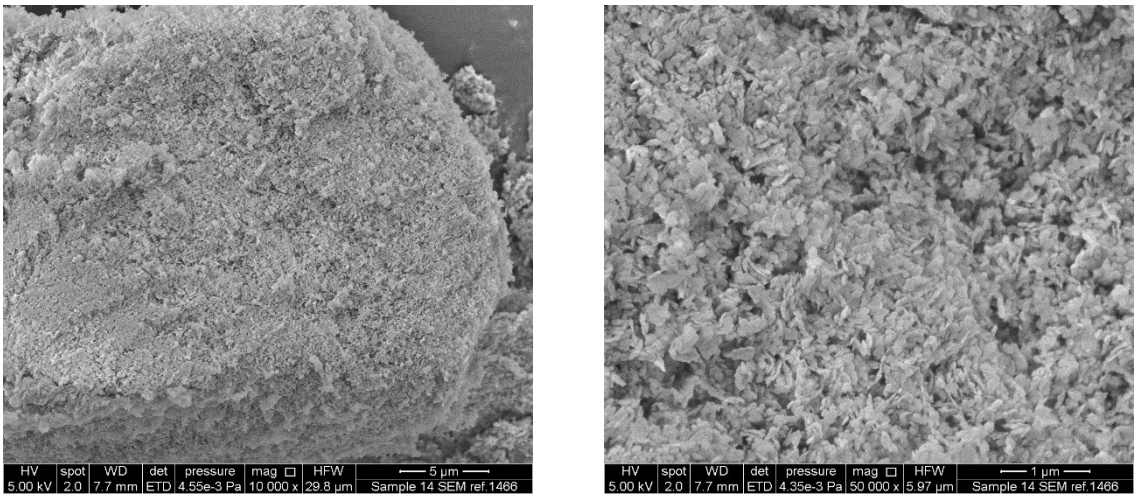
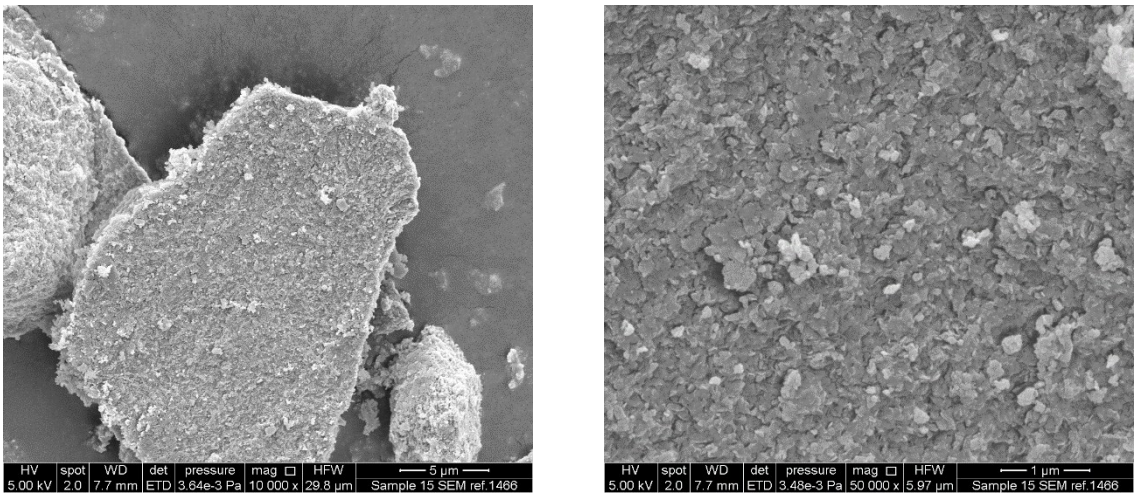


Figure S6. IR spectra of the drug intercalates prepared by self-assembly.

LGdH-dic-sa



LGdH-ibu-sa



LGdH-nap-sa

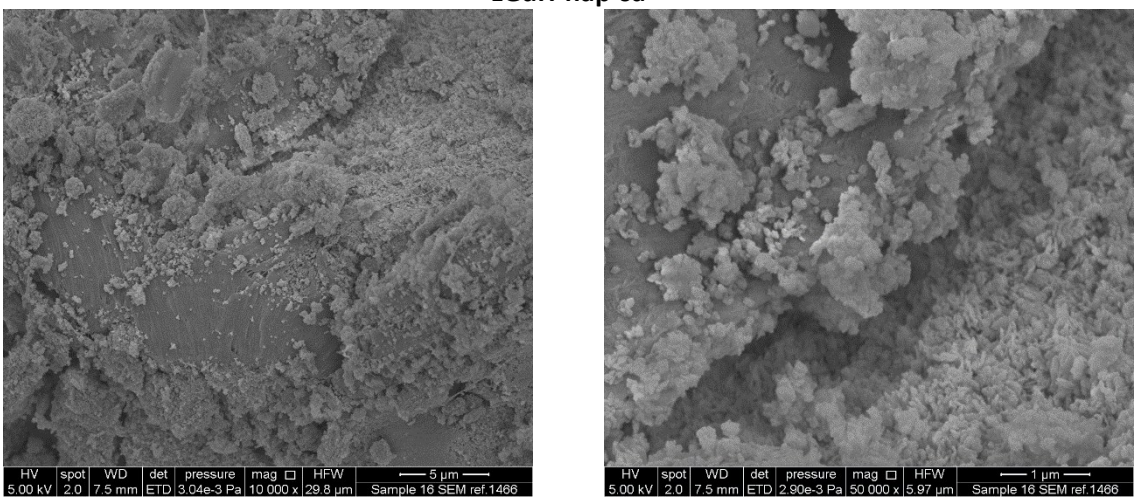


Figure S7. SEM images of the drug intercalates prepared by self-assembly.

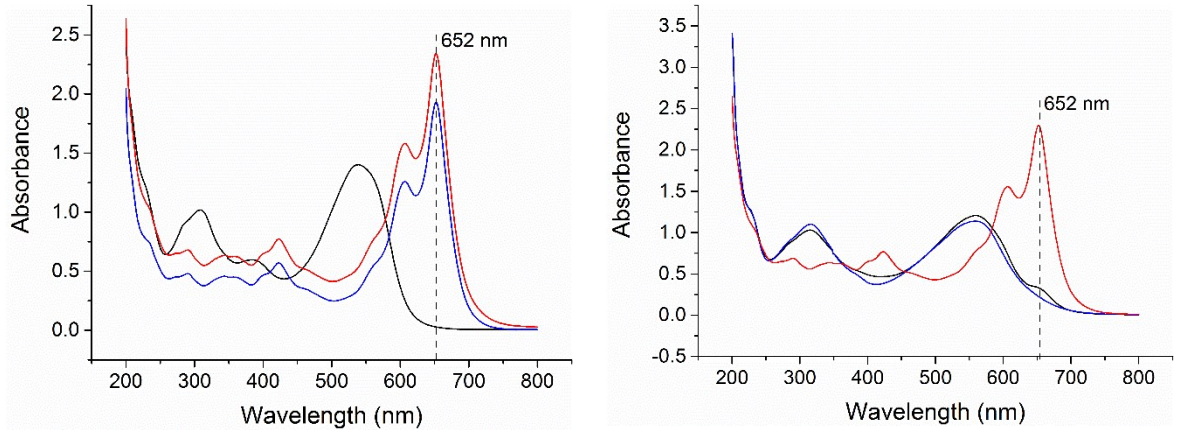


Figure S8: Assessment of the stability of LGdH-Cl at (a) pH 1.5 for 2 h, and (b) pH 7.4 for 24 h, as measured using the Arsenazo III assay. Data are shown for the release medium (negative control; HCl or PBS; –); $GdCl_3$ (positive control; –), and LGdH-Cl (–).

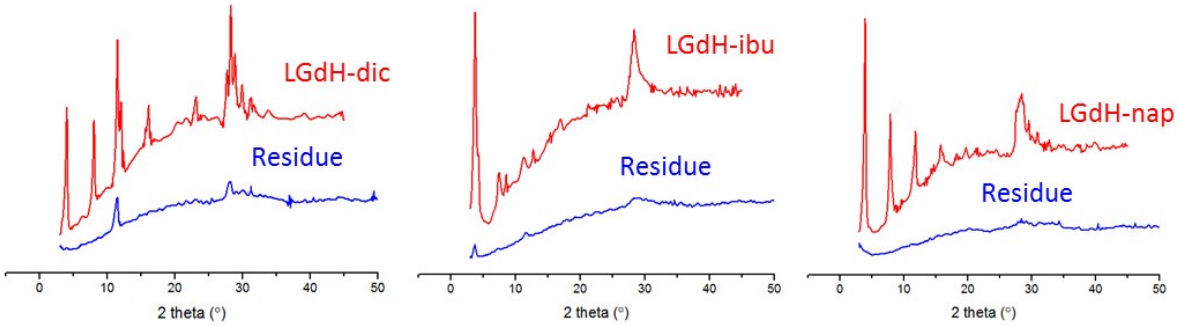
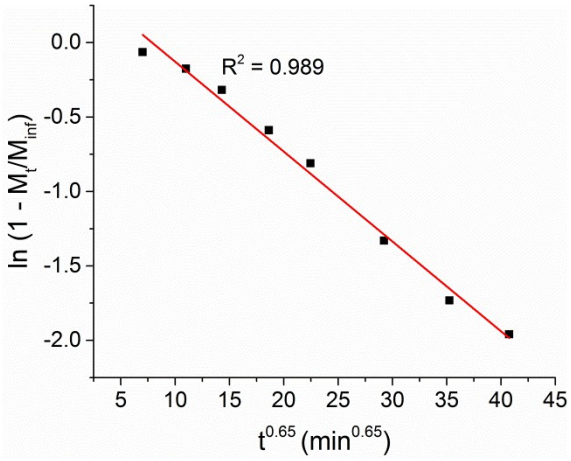
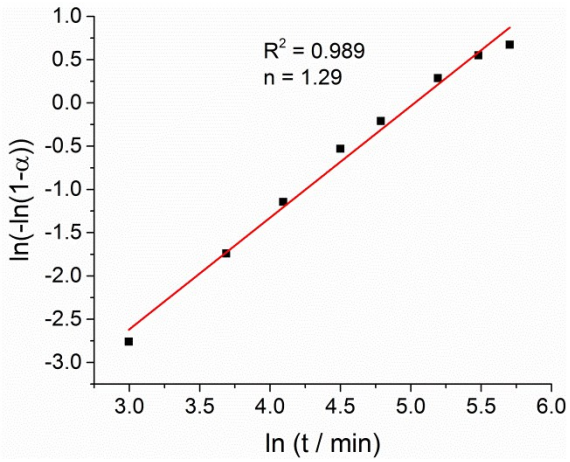


Figure S9: XRD patterns for the LGdH-drug composites prepared by ion exchange (top) and the residual solids recovered from release studies (bottom).

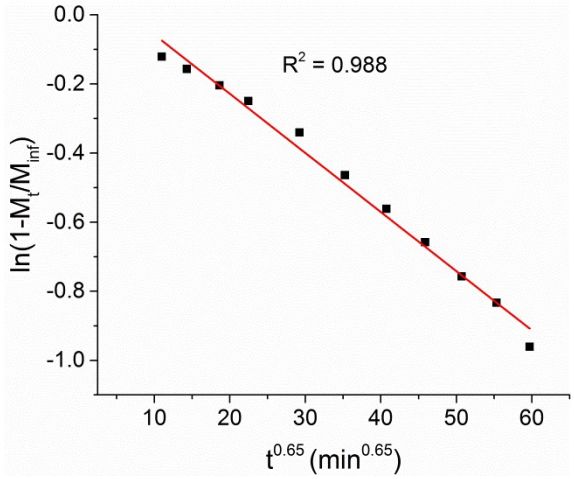


Bhaskar model



Avrami-Erofe'ev model

(a)



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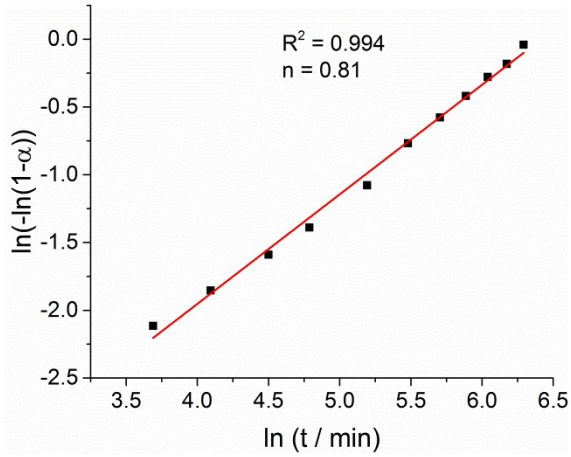
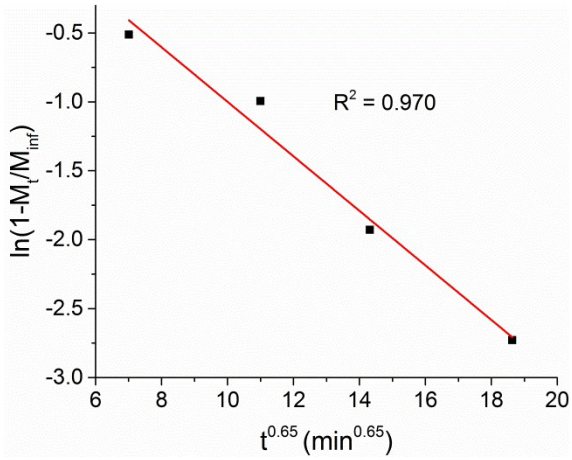


Avrami-Erofe'ev model

(b)



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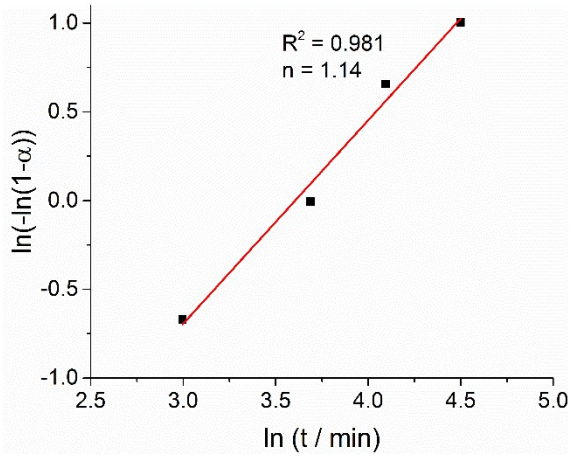
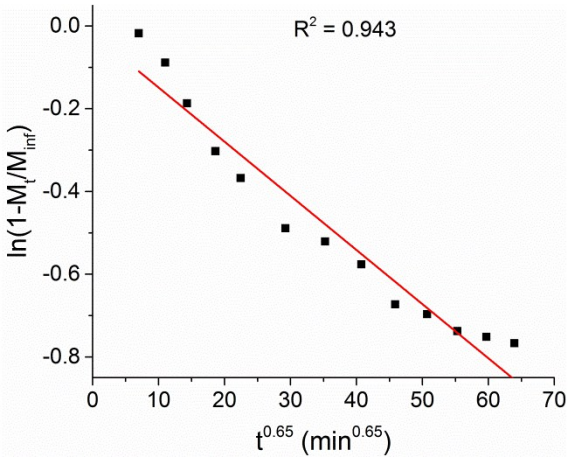
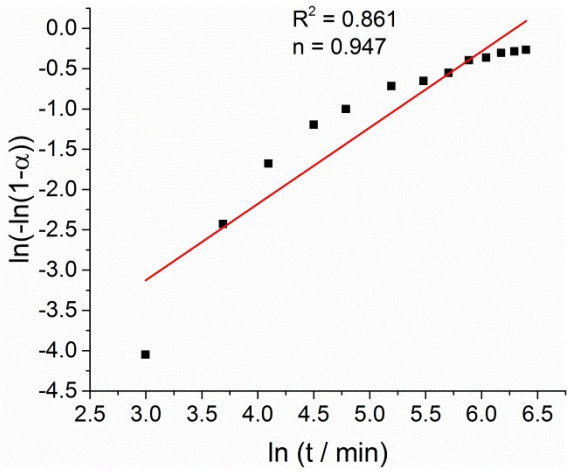


Avrami-Erofe'ev model

(c)

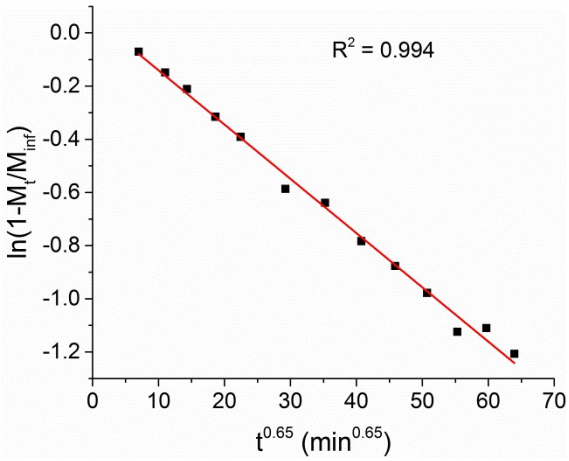


Bhaskar model

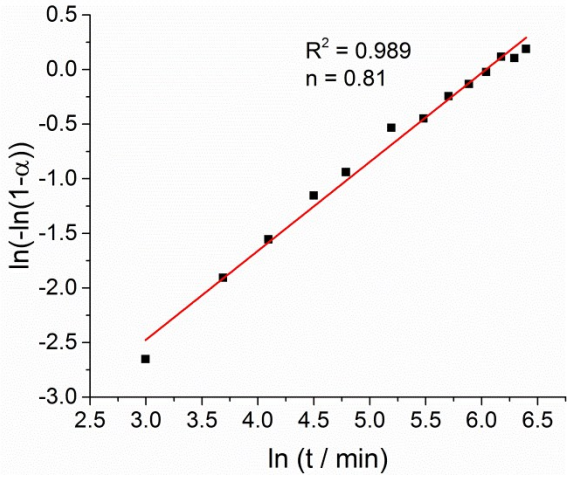


Avrami-Erofe'ev model

(d)



Bhaskar model



Avrami-Erofe'ev model

(e)

Figure S10: Fits of the Bhaskar and Avrami-Erofe'ev models to the release data for (a) LGdH-dic; (b) LGdH-ibu; (c) LGdH-nap; (d) LGdH-ibu-c (pH 8); and, (e) LGdH-ibu-c (pH 12).

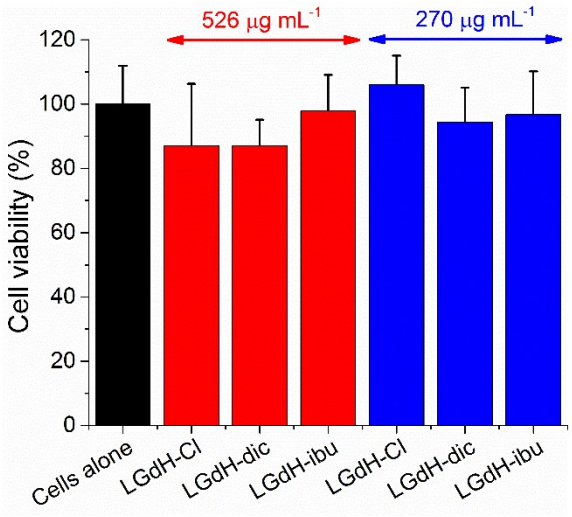


Figure S11. The results of *in vitro* cell viability studies with solutions made from selected LGdH materials. Experiments were performed with solutions of the LGdHs at concentrations of 526 (red bars) or 270 (blue bars) μg mL^{-1}. Results are shown as mean ± S.D. from three independent experiments, each containing three replicates.