

In situ Hydrophobization of Lithium Aluminate Particles for Flotations by Dry Grinding in the Presence of Punicines

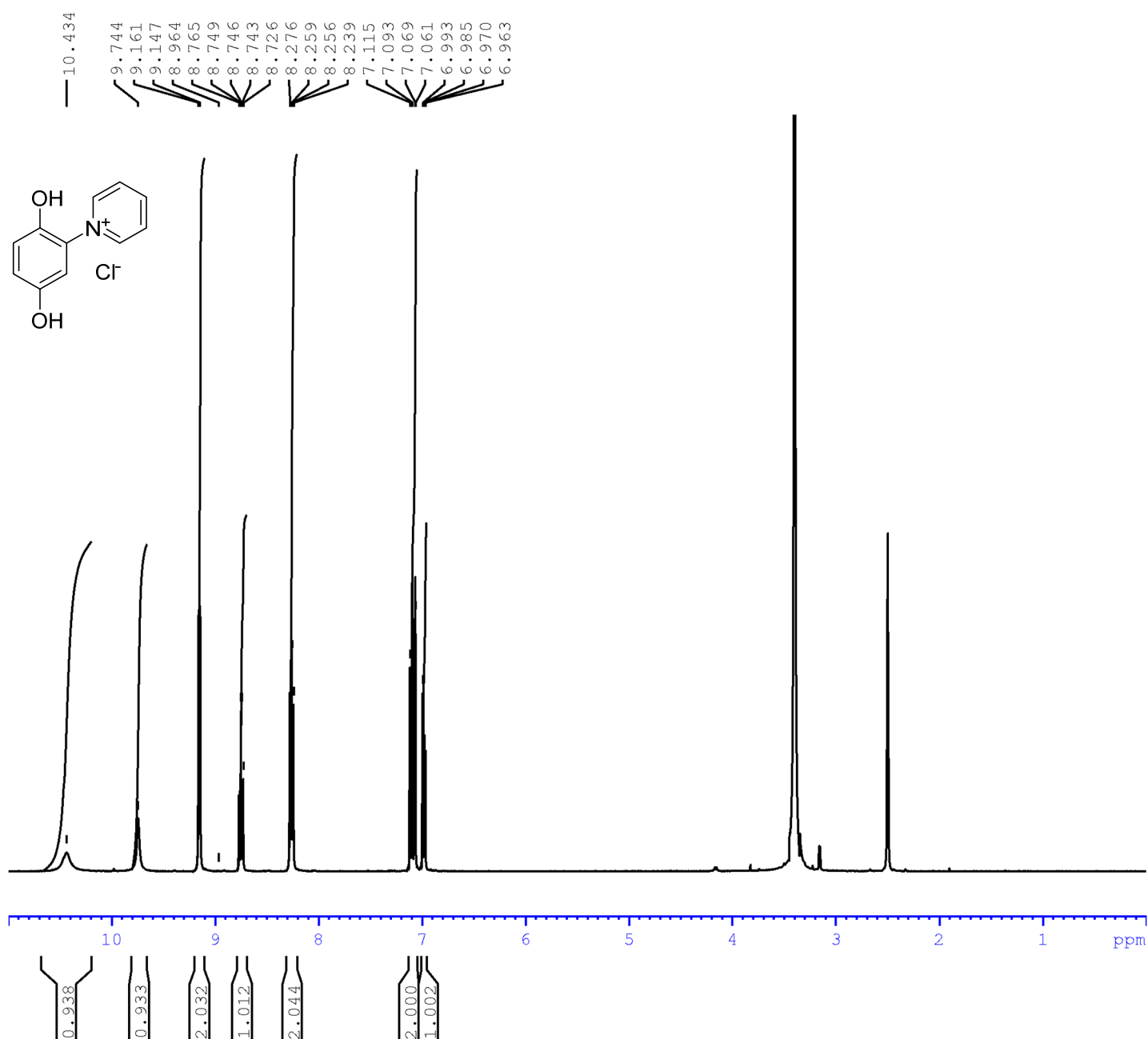
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1. NMR spectra of the punicines

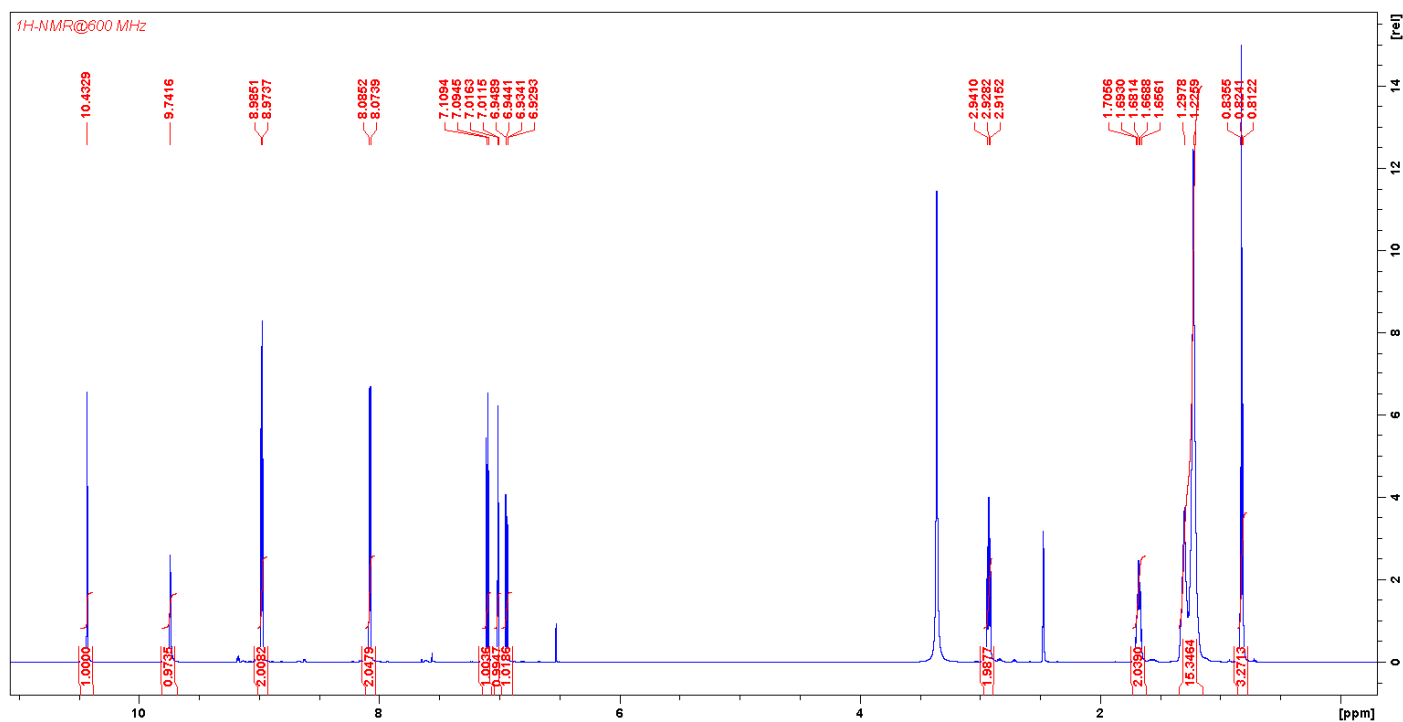
S1. Punicine 1 (1-(2',5'-dihydroxyphenyl)-pyridinium chloride)

Figure 1: ^1H -NMR of punicine 1

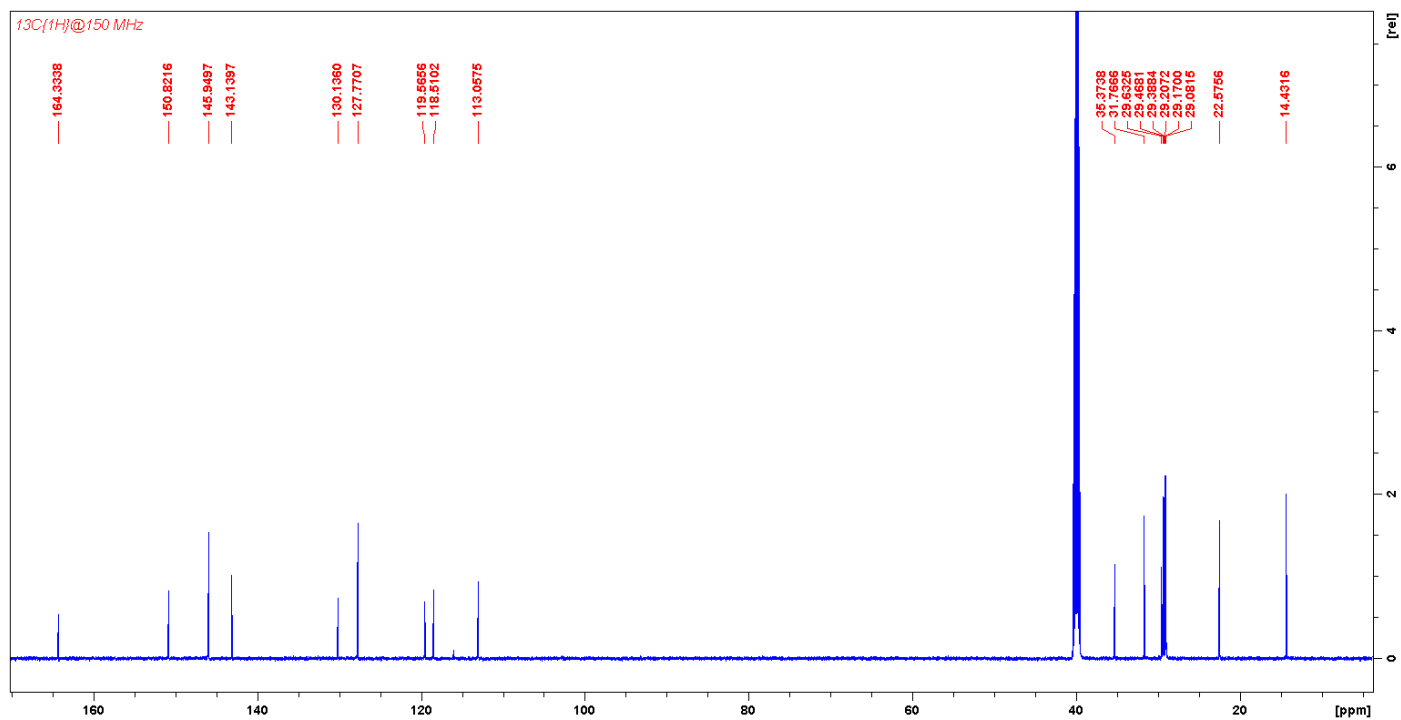
S2. C₁₀-Punicine (1-(2',5'-dihydroxyphenyl)-4-decanylpuridinium chloride)

Physical and spectroscopic data:

Melting point: 138.5°C. ¹H NMR (600 MHz, DMSO-d₆) δ = 10.46 (s, 1H, *o*-OH), 9.77 (s, 1H, *p*-OH), 9.00 (d, $J_{\text{H-H}}$ = 6.8 Hz, 2H), 8.11 (d, $J_{\text{H-H}}$ = 6.8 Hz, 2H), 7.13 (d, $J_{\text{H-H}}$ = 8.8 Hz, 1H), 7.01 (d, $J_{\text{H-H}}$ = 2.9 Hz, 1H), 7.04 (dd, $J_{\text{H-H}}$ = 8.8, 2.9 Hz, 1H), 2.96 (t, $J_{\text{H-H}}$ = 7.6 Hz, 2H), 1.71 (quint., $J_{\text{H-H}}$ = 7.6 Hz, 2H), 1.33–1.21 (bm, 14H), 0.85 (t, 3 H) ppm. ¹³C NMR (150 MHz, DMSO-d₆) δ = 163.3 (o, 1C), 150.1 (o, 1C), 145.2 (+, 2C), 142.4 (o, 1C), 129.4 (o, 1C), 127.0 (+, 2C), 118.8 (+, 1C), 117.8 (+, 1C), 112.3 (+, 1C), 34.6 (-, 1C), 31.0 (-, 1C), 28.4; 28.4; 28.5; 28.6; 28.7; 28.9 (-, 6C, C3 - C8), 21.8 (-, 1C), 13.7 (+, 1C) ppm. IR (ATR): ν = 3367, 3111, 3042, 2914, 2848, 2692, 1641, 1509, 1454, 1335, 1272, 1201, 1123, 907, 855, 817, 795, 720, 693, 630, 614, 556, 536, 469, 410 cm⁻¹. HR-MS ((+)-ESI): C₂₁H₃₀NO₂⁺ [M⁺] calc.: 328.2271; found: 328.2260.

¹H-NMR

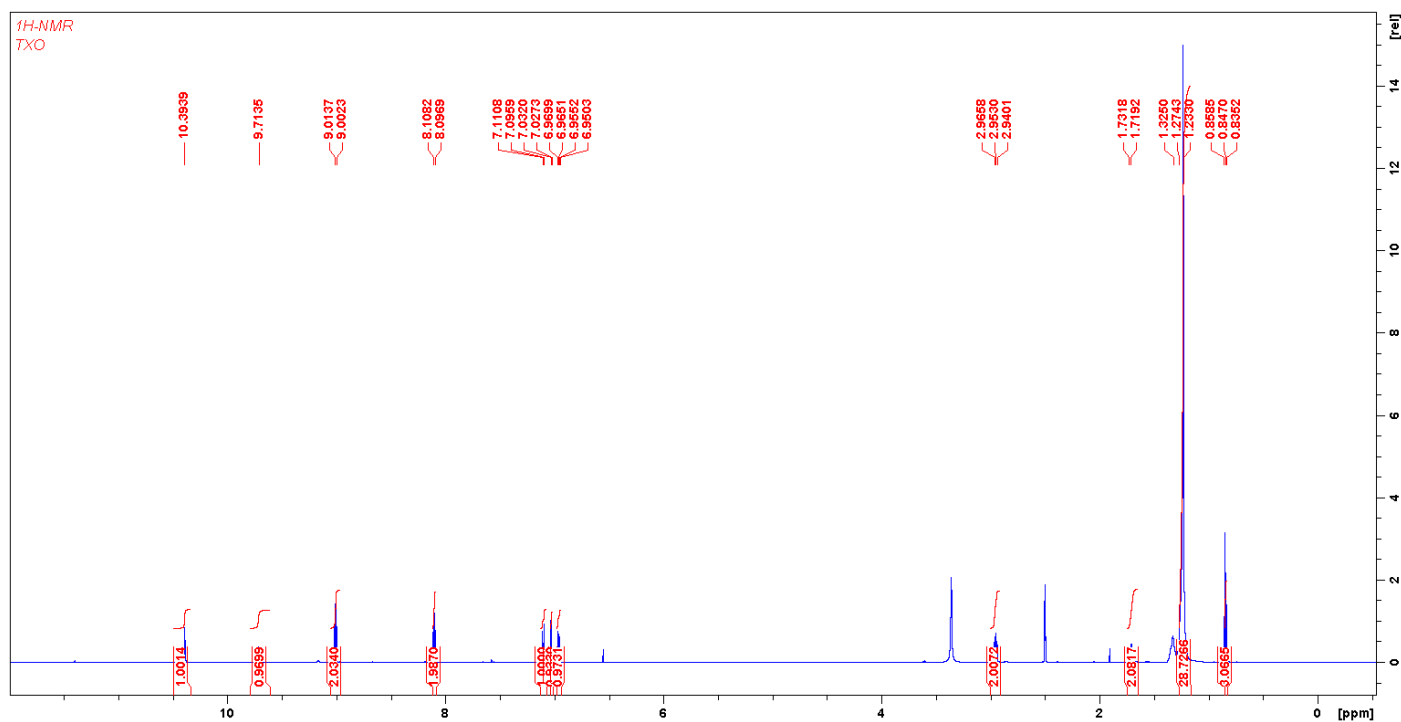
¹³C-NMR

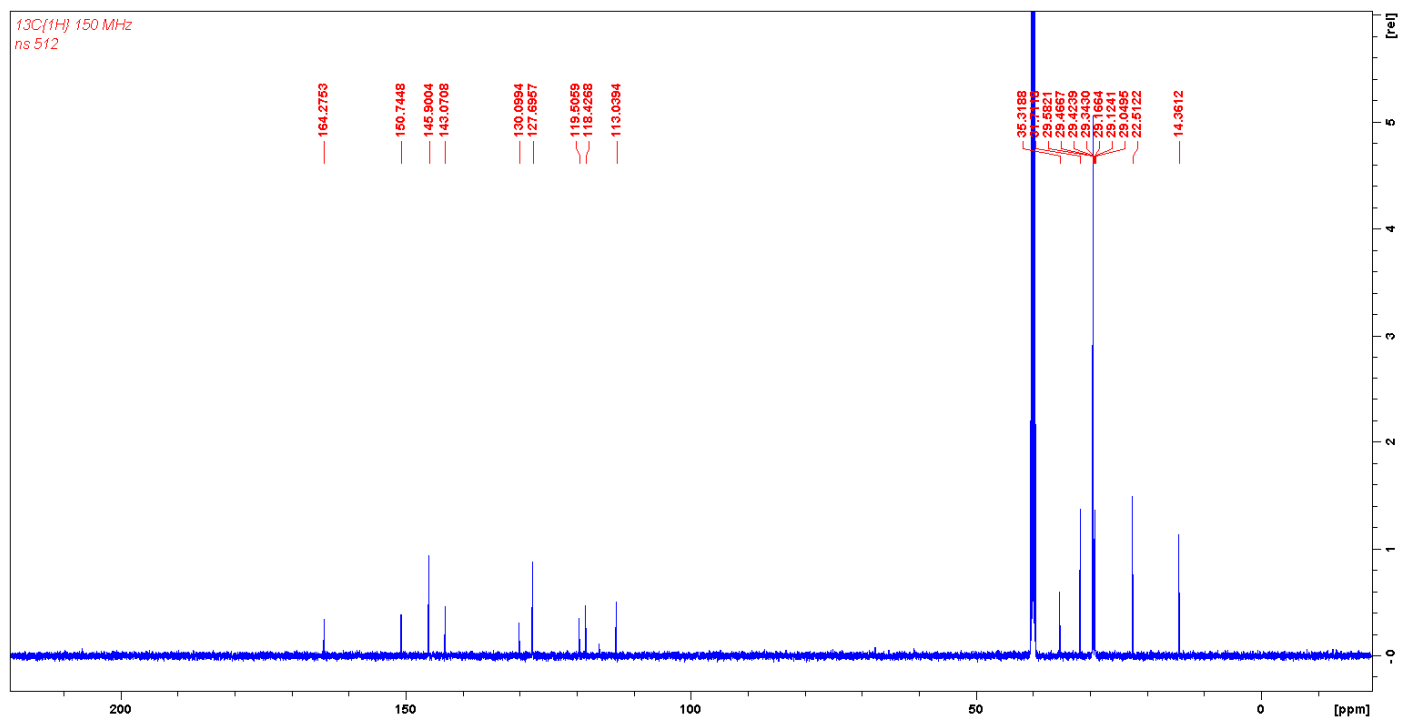


S3. C₁₇-Punicine (1-(2',5'-dihydroxyphenyl)-4-heptadecanypyridinium chloride)

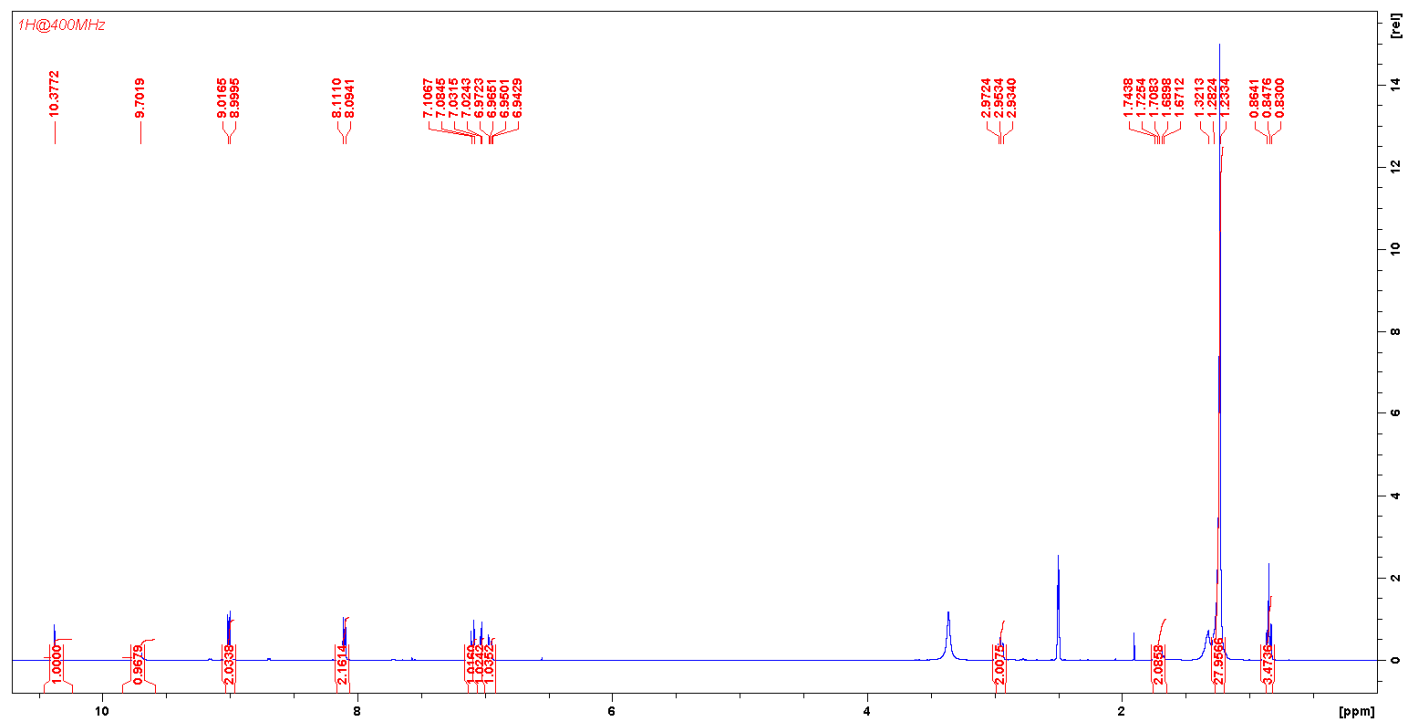
Physical and spectroscopic data:

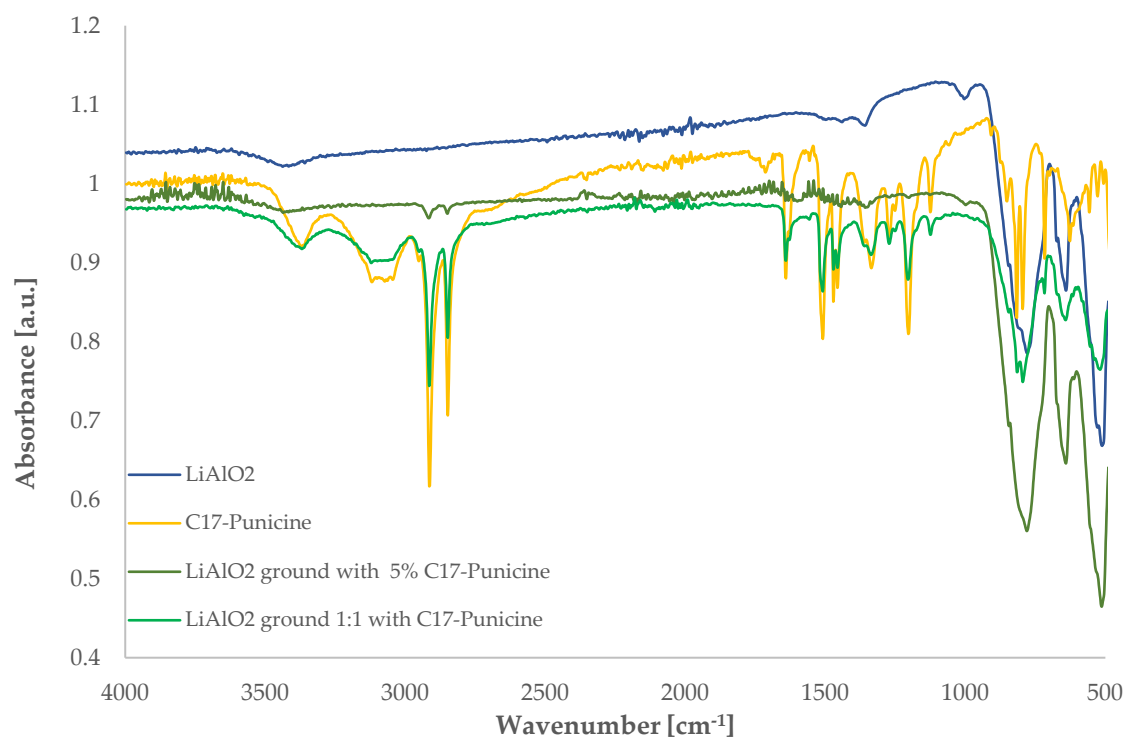
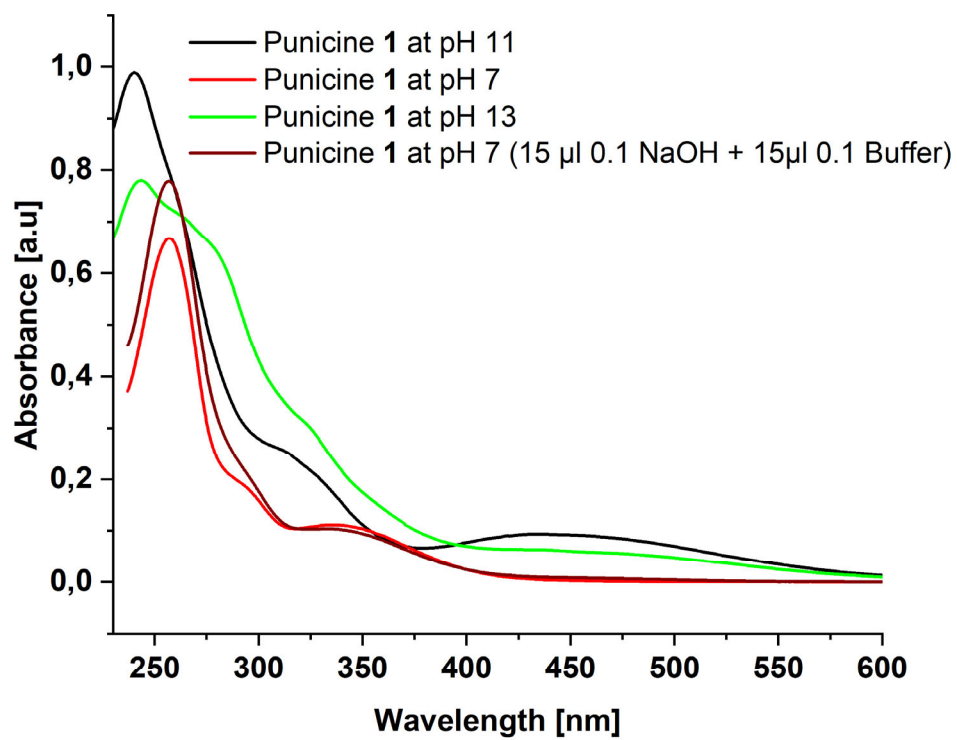
Melting point: 121 °C, ¹H NMR (600 MHz, DMSO-d₆) δ = 10.39 (s, 1 H, *o*-OH), 9.71 (s, 1 H, *p*-OH), 9.01 (d, *J*_{H-H} = 6.8 Hz, 2 H, pyr-H), 8.10 (d, *J*_{H-H} = 6.8 Hz, 2 H, pyr-H), 7.10 (d, *J*_{H-H} = 9.3 Hz, 1 H, Ar-H), 7.03 (d, *J*_{H-H} = 3.9 Hz, 1 H, Ar-H), 6.96 (dd, *J*_{H-H} = 9.3 Hz, *J*_{H-H} = 3.9 Hz, 1 H, Ar-H), 2.95 (t, *J*_{H-H} = 7.9 Hz, 2 H, Alkyl-H), 1.70 (quint., *J*_{H-H} = 7.9 Hz, 2 H, Alkyl-H), 1.23 (m, 28 H, Alkyl-H), 0.85 (t, *J*_{H-H} = 6.5 Hz, 3 H, terminal alkyl-H) ppm. ¹³C NMR (150 MHz, DMSO-d₆) δ: 164.3 (o, 1C), 150.7 (o, 1C), 145.9 (+, 2C), 143.1 (o, 1C), 130.1 (o, 1C), 127.7 (+, 2C), 119.5 (+, 1C), 118.4 (+, 1C), 113.0 (+, 1C), 35.3 (-, 1C), 31.7 (-, 1C), 29.6 (-, 1C), 29.5 (-, 7C), 29.4 (-, 1C), 29.3 (-, 1C), 29.2 (-, 1C), 29.1 (-, 1C), 29.0 (-, 1C), 22.5 (-, 1C), 14.4 (+, 1C) ppm. IR(ATR): ν = 3373, 3319, 2913, 2848, 1641, 1509, 1470, 1456, 1335, 1272, 1251, 1202, 1124, 852, 816, 795, 716, 626, 557, 528, 470. HR-MS ((+)-ESI): C₂₈H₄₄NO₂⁺ [M⁺] calc.: 461.3061; found: 461.3059.

¹H-NMR

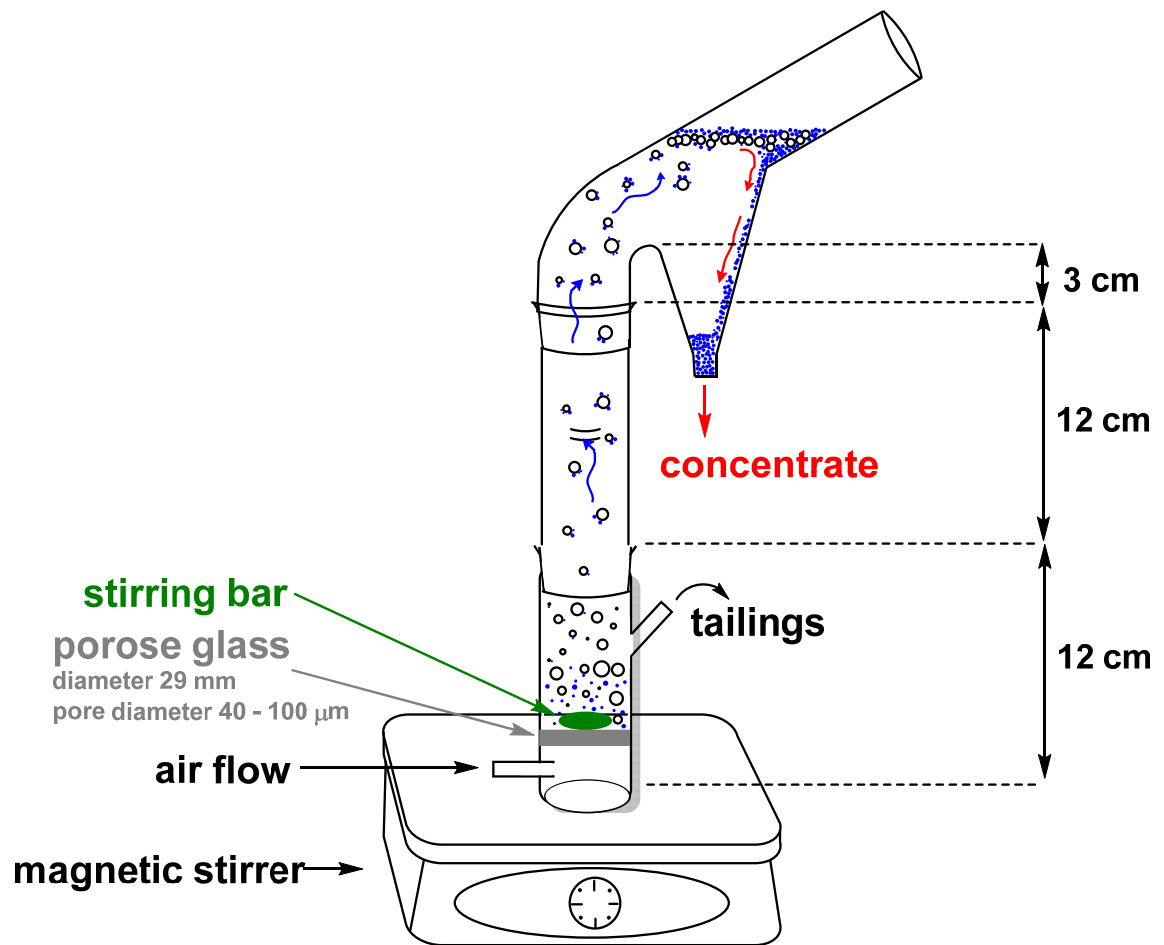
^{13}C -NMR

S4. C_{17} -Punicine (1-(2',5'-dihydroxyphenyl)-4-heptadecanypyridinium chloride) after grinding

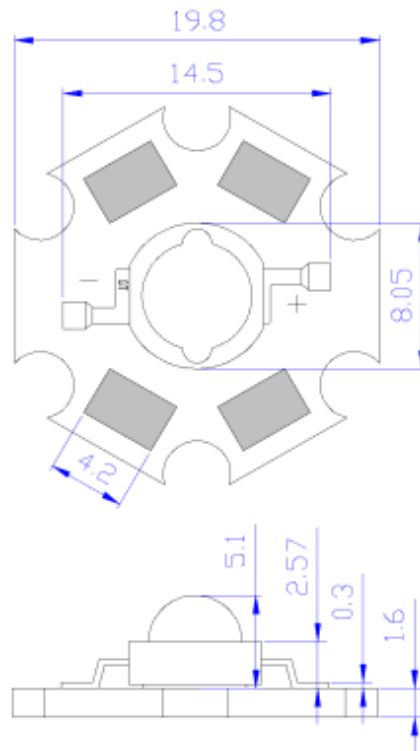
 ^1H -NMR

S5. IR-Spectra of C₁₇-Punicine; pure and ground with LiAlO₂S6. UV-Vis spectra of C₀-Punicine at different pH

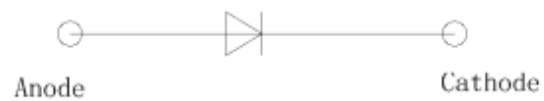
S7. Hallimond Tube with dimensions



S8. Specification of LEDs

Outline Dimensions**1、 Dome Type****2、 Circuit diagram**

INTERNAL CIRCUIT DIAGRAM

**Notes**

1. All dimensions are in millimeters.(tolerance:±0.2)

2. Dimension Scale:1:1

*The appearance and specifications of the product may be changed for improvement without notice.

Parameters

Electrical-Optical Characteristics at IF=750mA, Ta=25℃

Parameter	Symbol	Min	Typ	Max	Unit
Radiation flux	ϕ_e	900	~	1000	mw
Wavelength	λ_D	390	~	400	nm
Forward Voltage	V_F	3.5	~	4.5	V
Power Dissipation	P_D	2.63	~	3.38	W
View Angle	2 θ 1/2	~	120	~	deg.
Thermal Resistance	$R\theta_{J-B}$	~	12	~	℃/W

Absolute Maximum Ratings

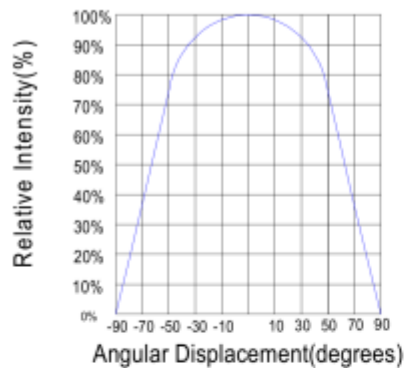
Parameter	Symbol	Value	Unit
Forward Current	I_F	750	mA
Junction Temperature	T_j	115	℃
Operating Temperature	T_{opr}	-40~+60	℃
Storage Temperature	T_{stg}	0~+60	℃
ESD Sensitivity	~	±2,000V HBM	~
Temperature Coefficient of voltage	~	-5	mV/℃
DC Pulse Current(@ 1 KHz,10% duty cycle)	I_{FP}	1000	mA
Reverse Voltage	V_R	Not designed for reverse operation	

*Notes

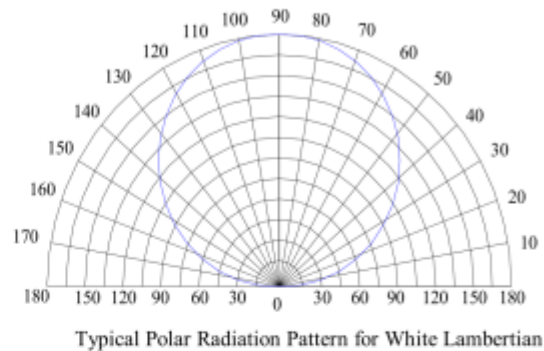
1. Tolerance of Luminous Flux is ±3%.
2. Tolerance of Forward Voltage is ±0.1V.

Typical Characteristic Curves(1)

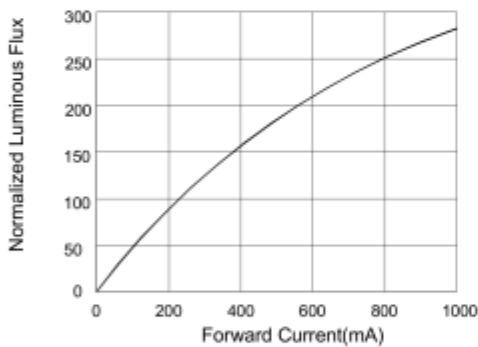
1. Typical Light Distribution Curve



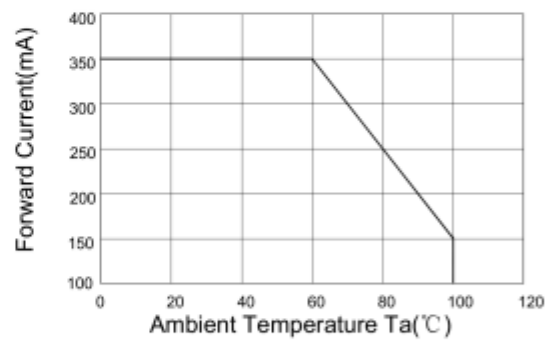
2. Typical Light-Emitting Angle Radiation Pattern



3. Forward Current vs. Relative Luminous Flux Curve

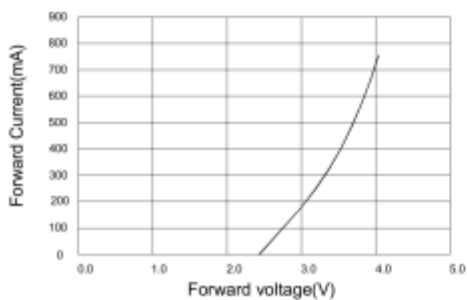


4. Forward Current Derating Curve, Derating based on $T_{max}=125^{\circ}\text{C}$

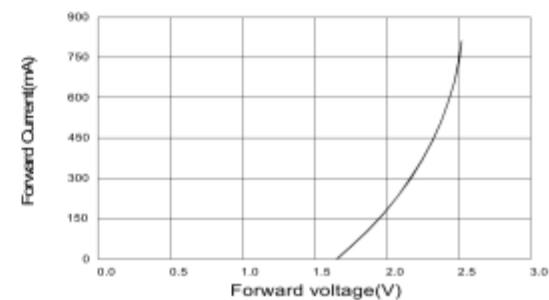


5. Electrical Characteristics Curve

5-1. White, Royal Blue, Blue, Green

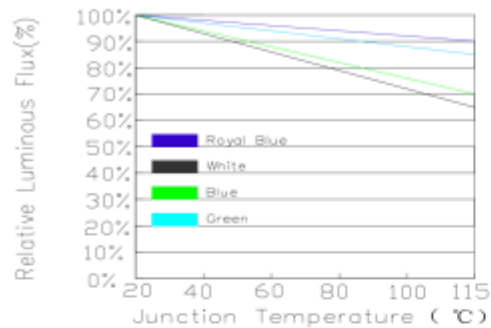


5-2. Amber, Red

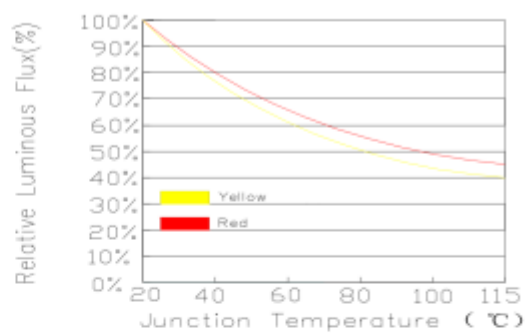


Typical Characteristic Curves(2)

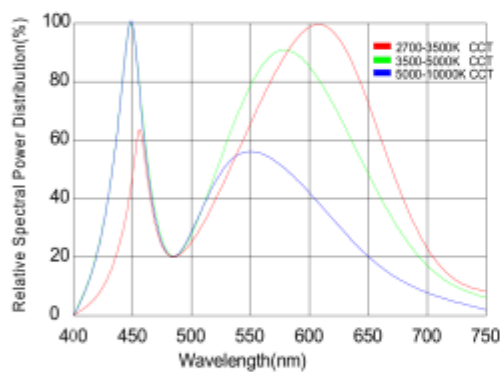
6-1. Relative Flux vs. Junction Temperature (If = 350 mA)
White, Royal Blue, Blue, Green



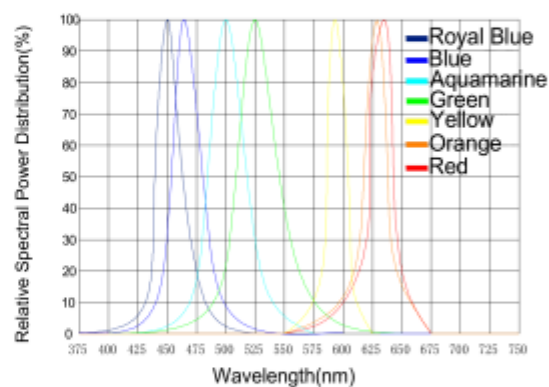
6-2. Relative Flux vs. Junction Temperature (If = 400 mA)
Amber, Red



7. Typical white spectral distribution

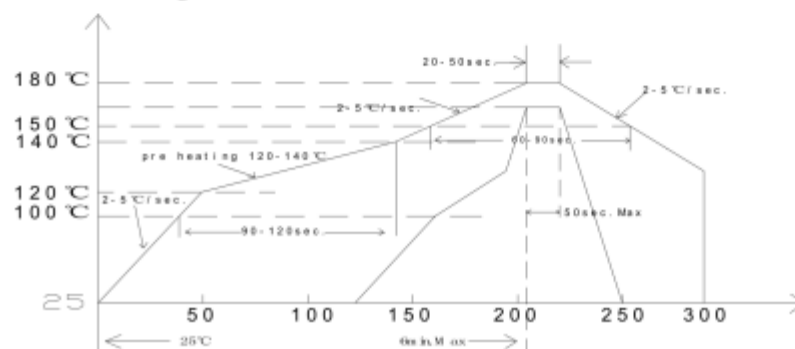


8. Relative Spectral Power Distribution



9. Reflow temperature time curve

Reflow Soldering Profile — Lead Free Solder



Reliability Test Items And Conditions

Test Items	Test Condition	Test Hours Cyles	Sample Size	Ac/Re
DC Aging	Ta=25℃ IF=750mA	1000H	22	0/1
Hot and cold shock	-40℃/30min +100℃/30min	100Cycles	22	0/1
High Temperature Storage	Ta=100℃	1000H	22	0/1
High Temperature High Humidity	85℃/85%RH	1000H	22	0/1
Low TemPerature Storage	Ta=-40℃	1000H	22	0/1
ESD(HBM)	2000V HBM	1Time	10	0/1

Criteria For Judging the Damage

Items	Symbol	Test Condition	Criteria For Judging Damage
Forward Voltage	V _F	I _F =750mA	Initial Data±10%
Reverse Current	I _R	V _R =5V	I _R ≤10μA
Luminous Flux	φ _v	I _F =750mA	Average φ _v degradation≤20% Single LED φ _v degradation≤30%

Soldering Condition

Reflow Soldering			Manual Welding	
	High temperature PC lens	Molding products	Temperature	Soldering time
Preheat	100-140℃	180-200℃	Highest 350℃	3ses once
Heatup time	120sec Max	120sec Max		
Peak temperature	180℃ Max	260℃ Max		
Condition of Soldering time	50sec Max	10sec Max		

***Notes**

Conventional PC lens products don't use reflow soldering.

