

FIG. 1

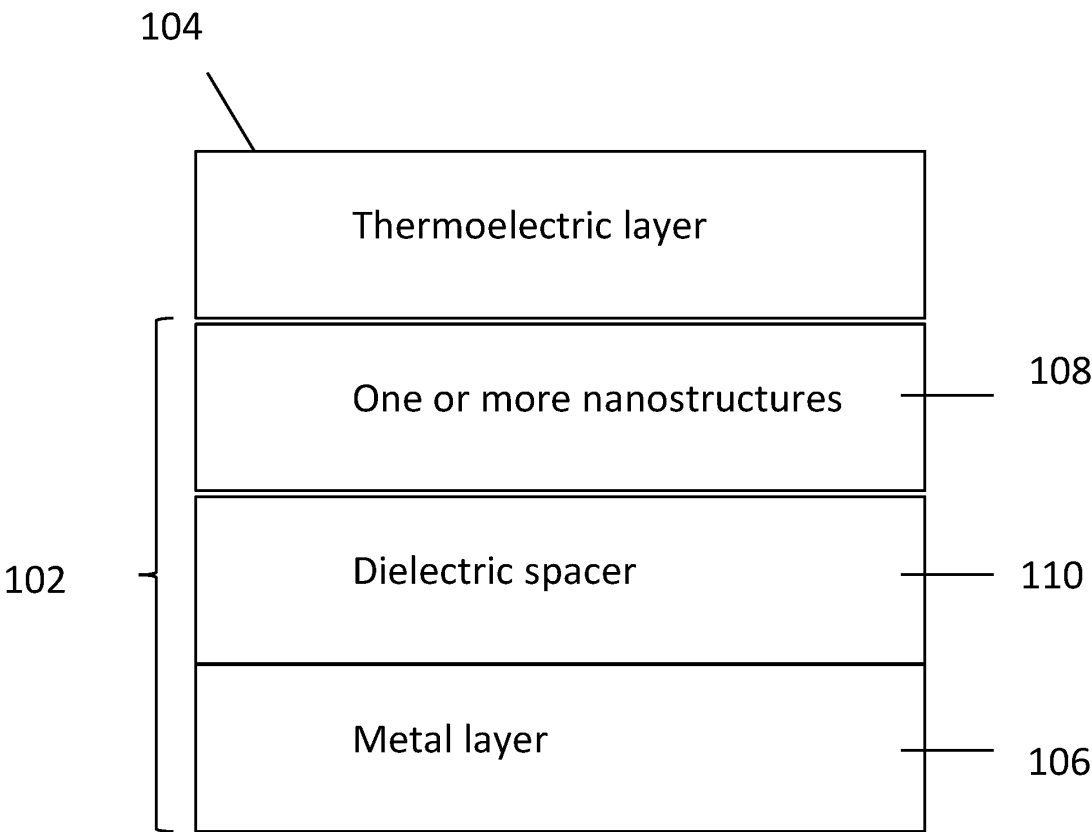


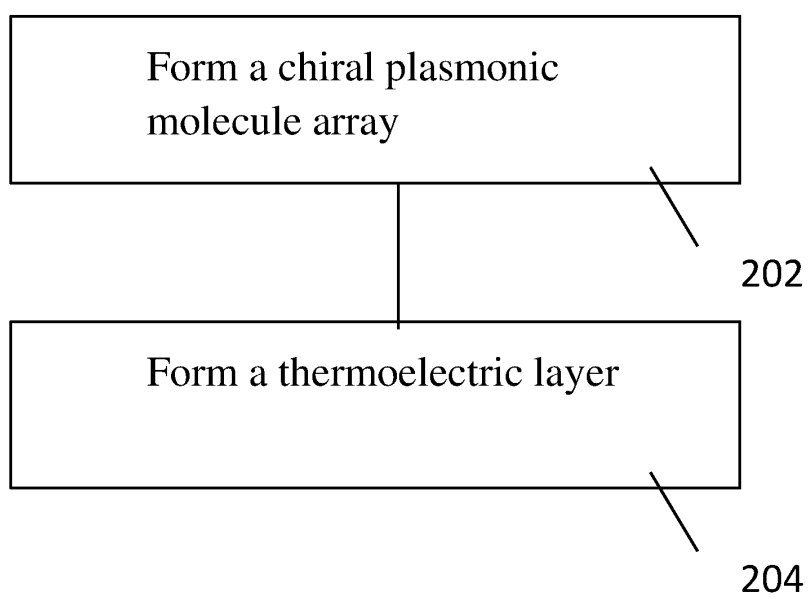
FIG. 2

FIG. 3A

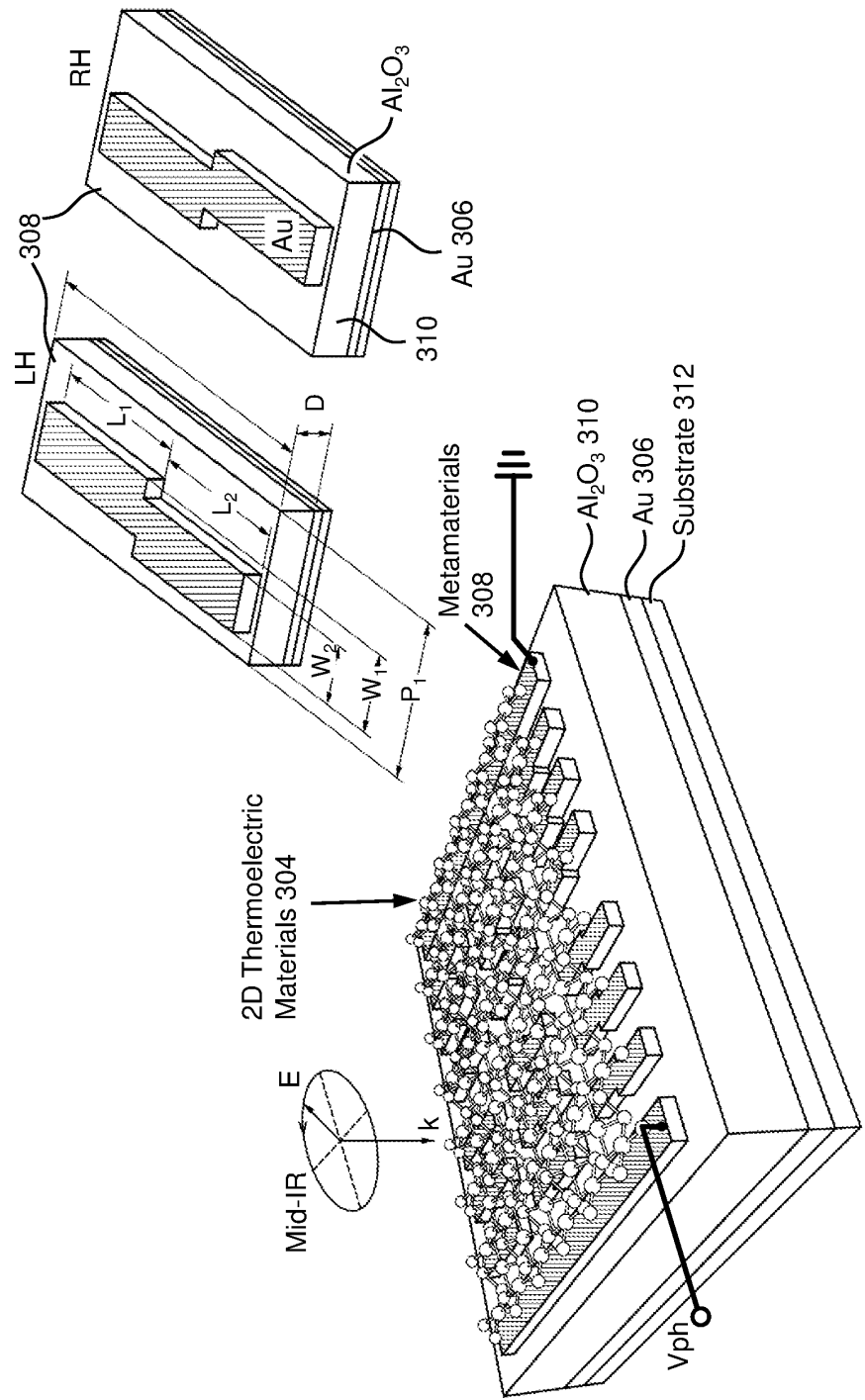


FIG. 3B

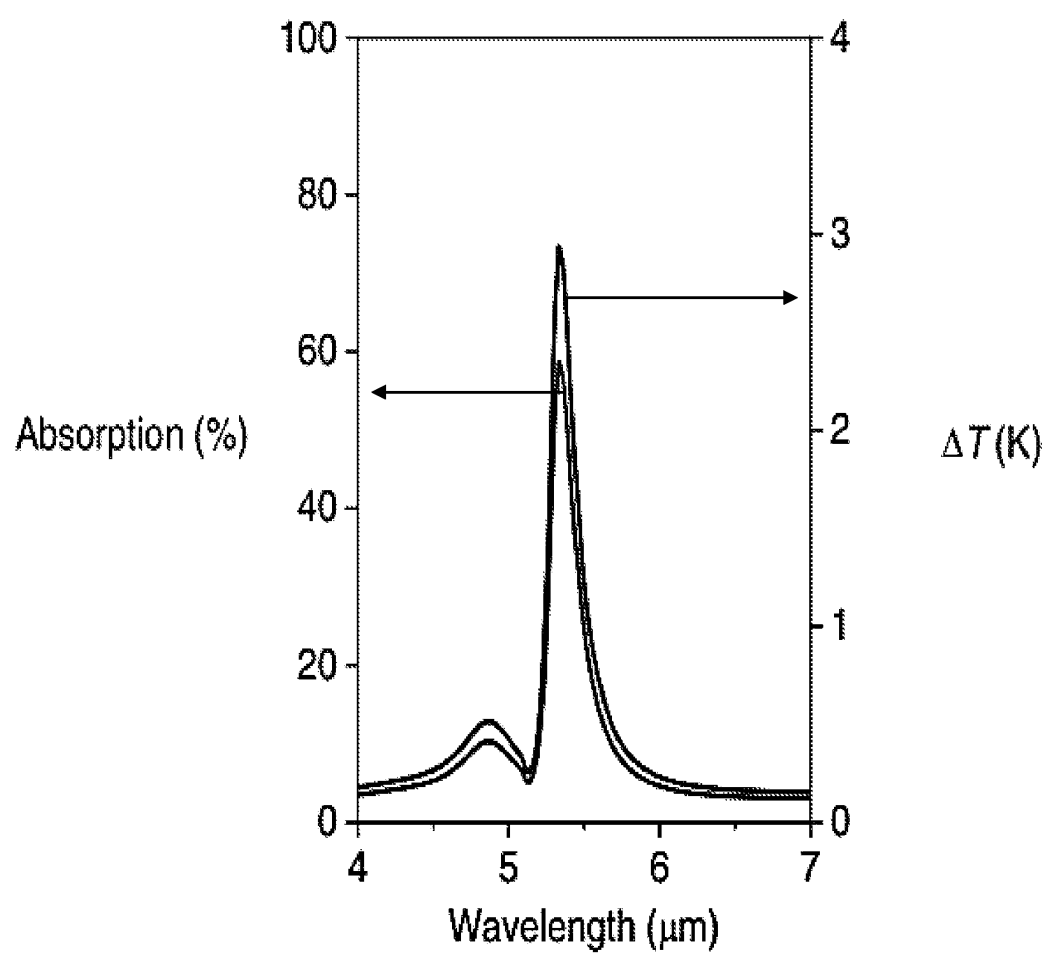


FIG. 3C

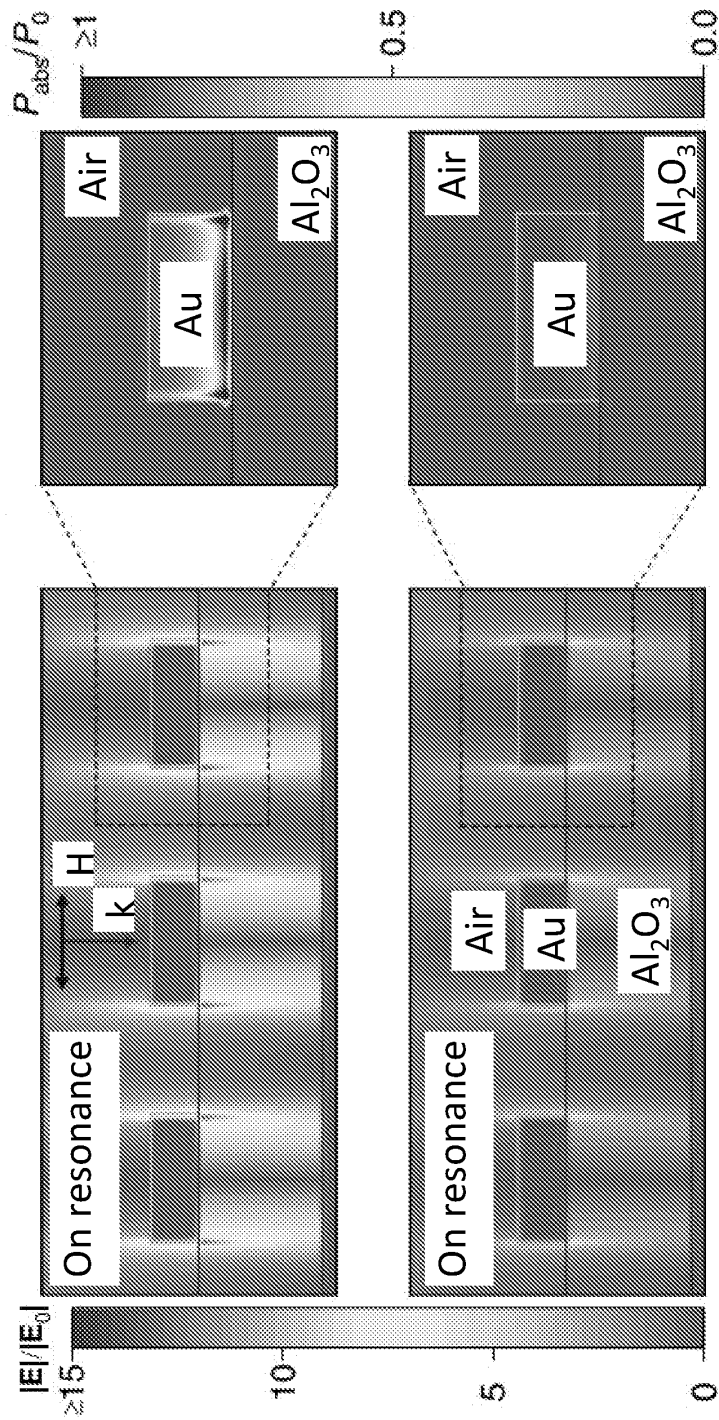


FIG. 3D

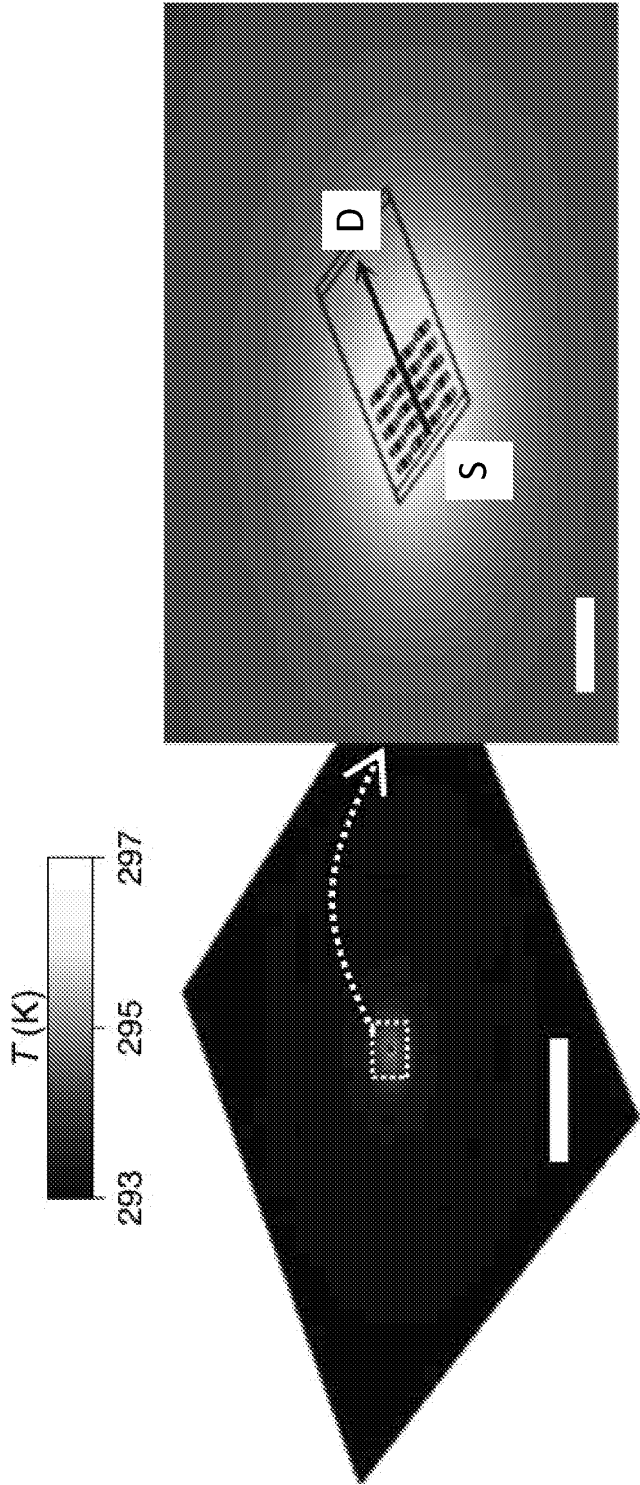


FIG. 3E

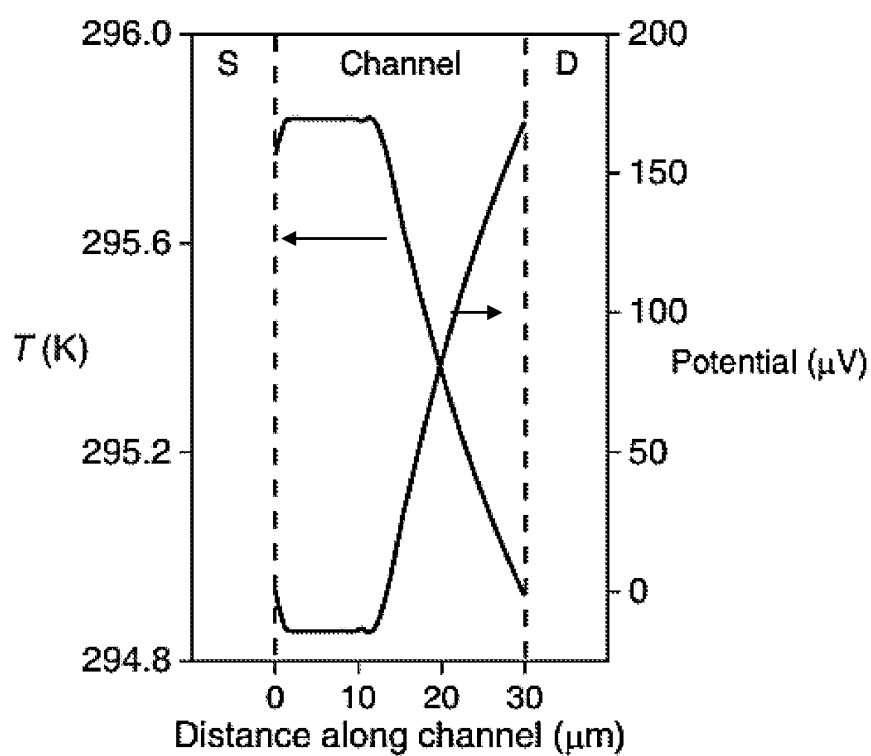


FIG. 4A

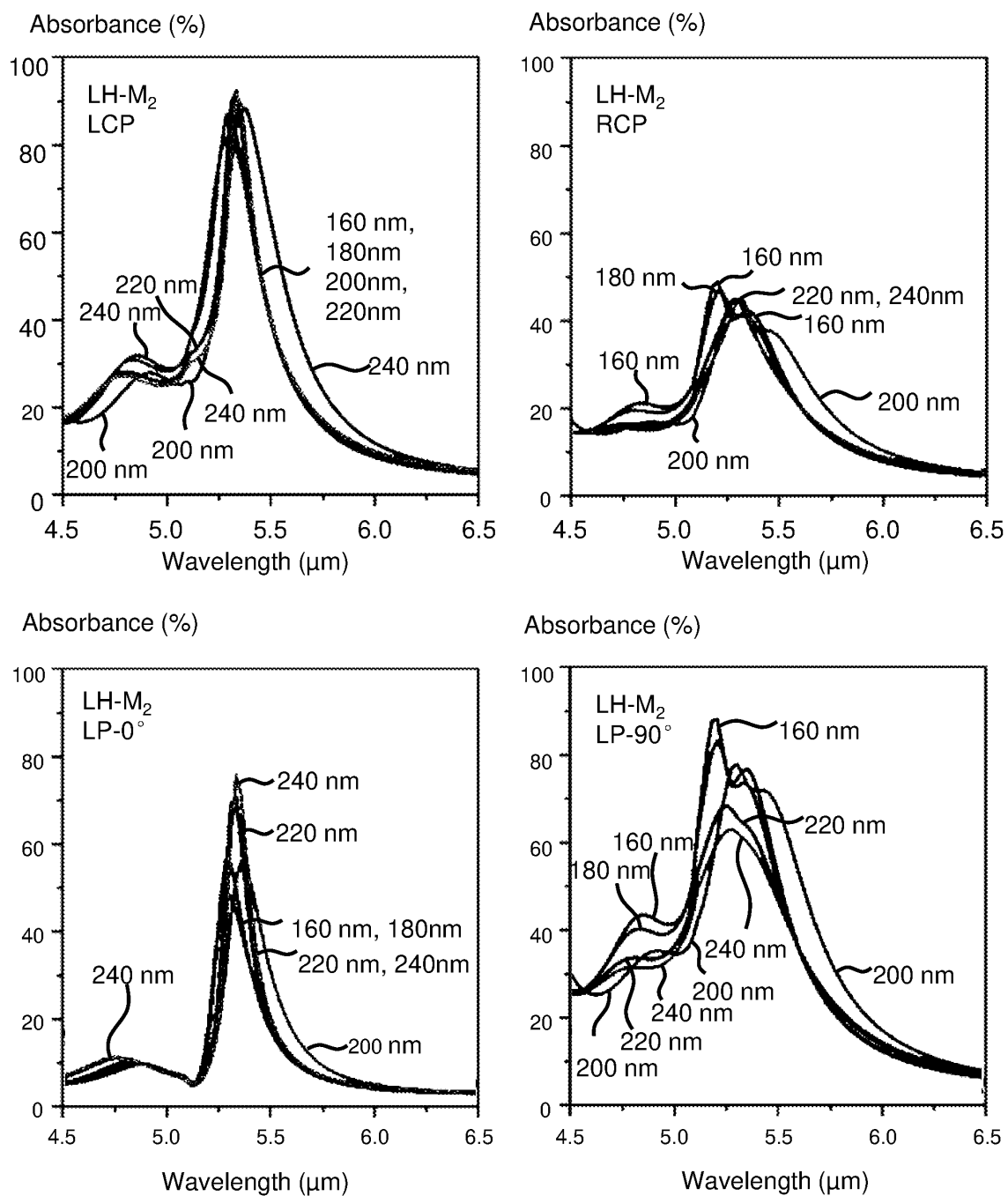


FIG. 4B

	Wavelength (nm)	P ₁ (nm)	P ₂ (nm)	L ₁ (nm)	L ₂ (nm)	W ₁ (nm)	W ₂ (nm)	D (nm)
M ₁	4500	4200	2500	1950	1400	1150	900	200
M ₂	5300	5100	2600	2300	1700	1360	1100	200
M ₃	6000	5600	2700	2700	2000	1570	1300	200
M ₄	7000	6600	3100	3300	2500	2000	1600	230
M ₅	8000	7600	4100	4000	3000	2600	2100	270

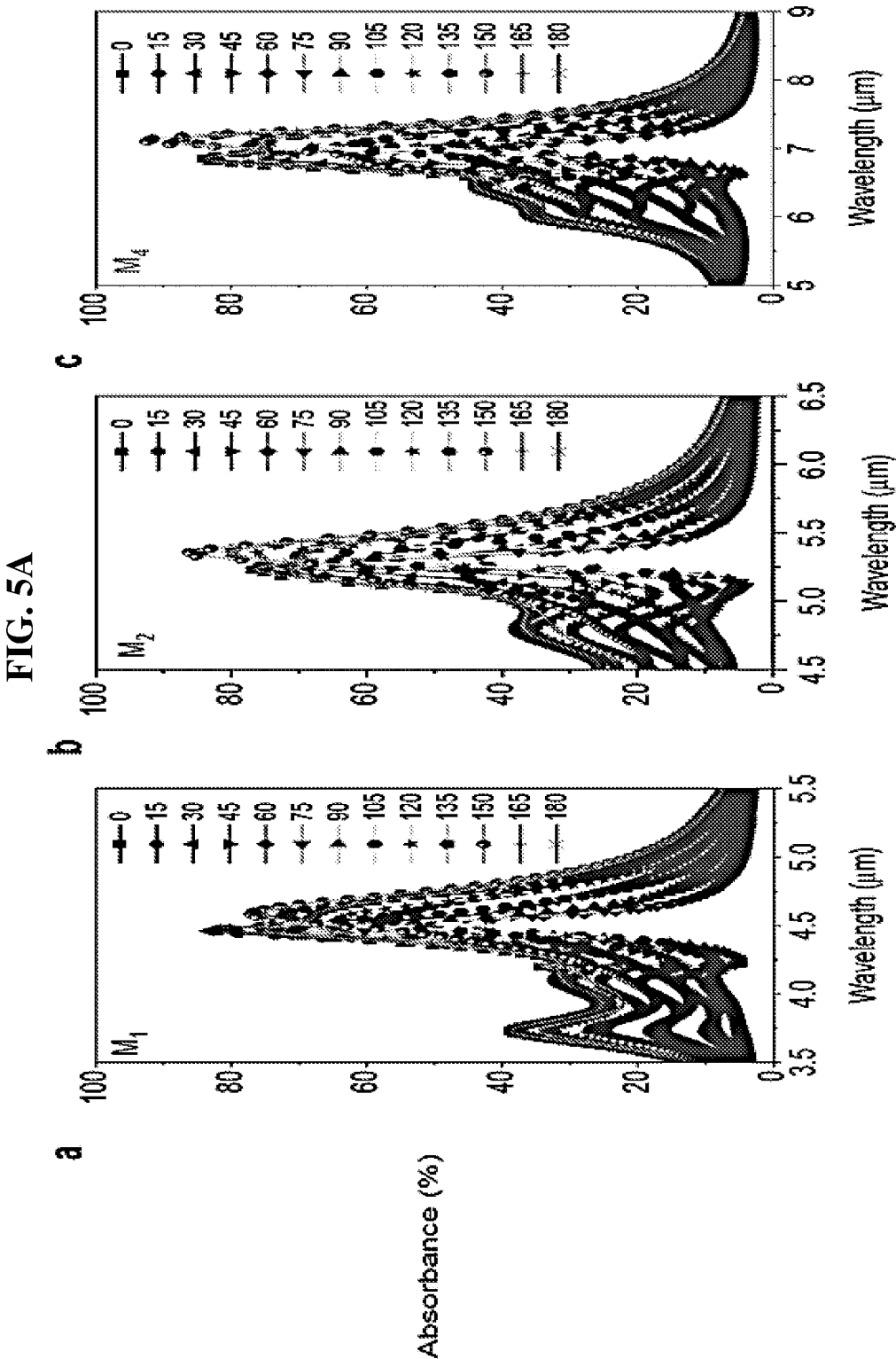


FIG. 5B

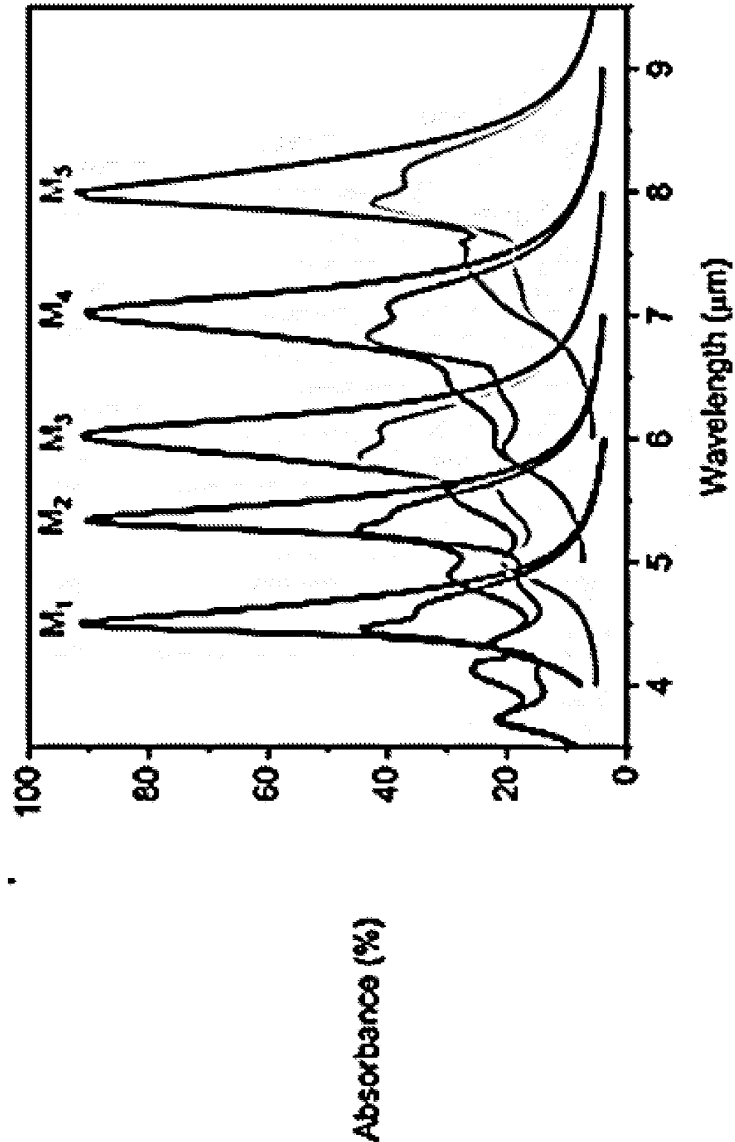


FIG. 5C

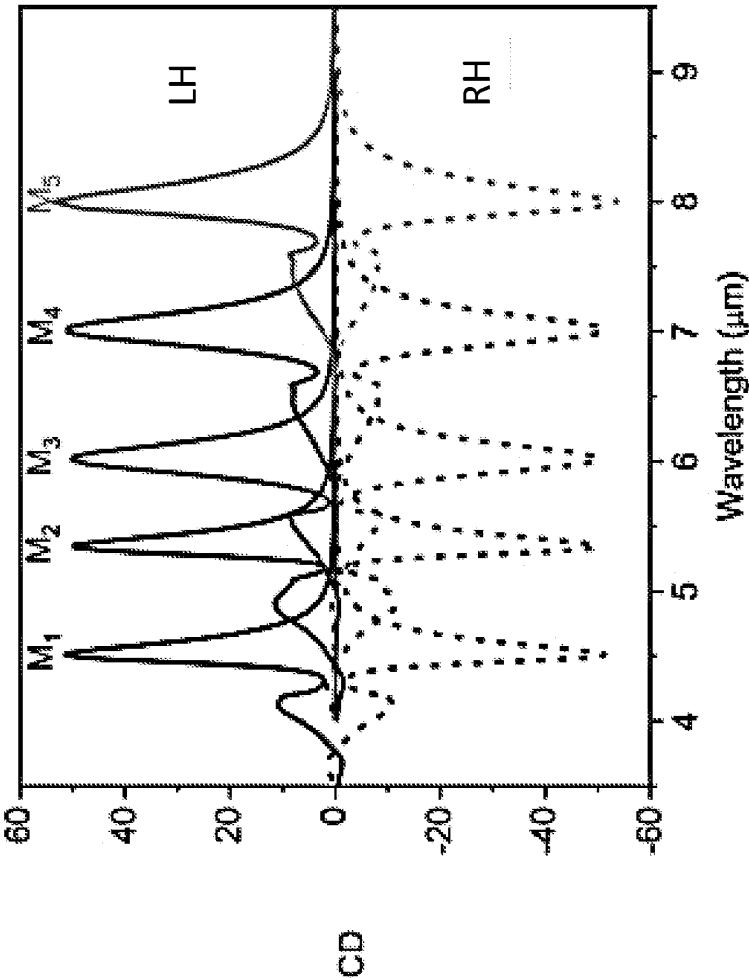
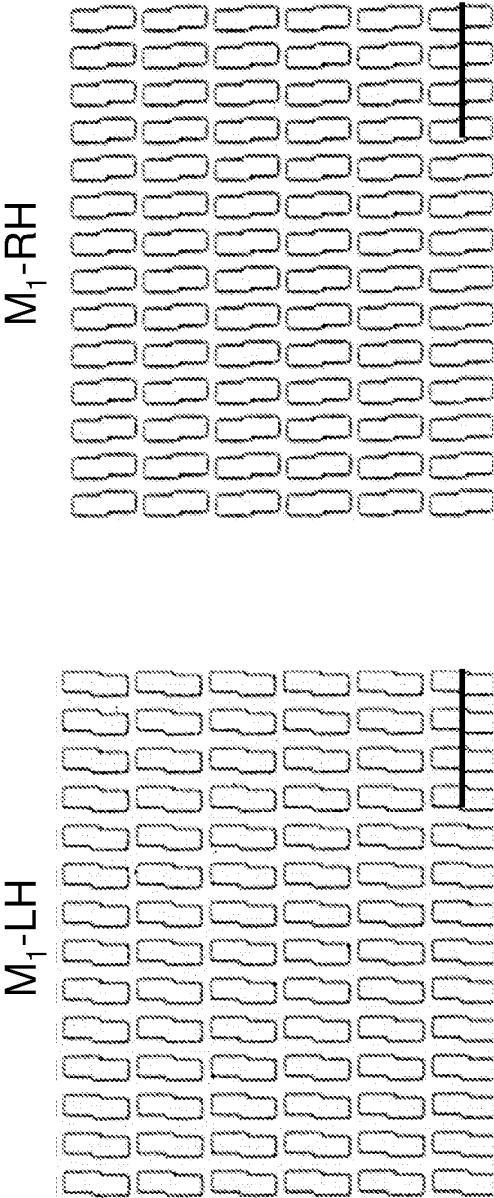


FIG. 6A



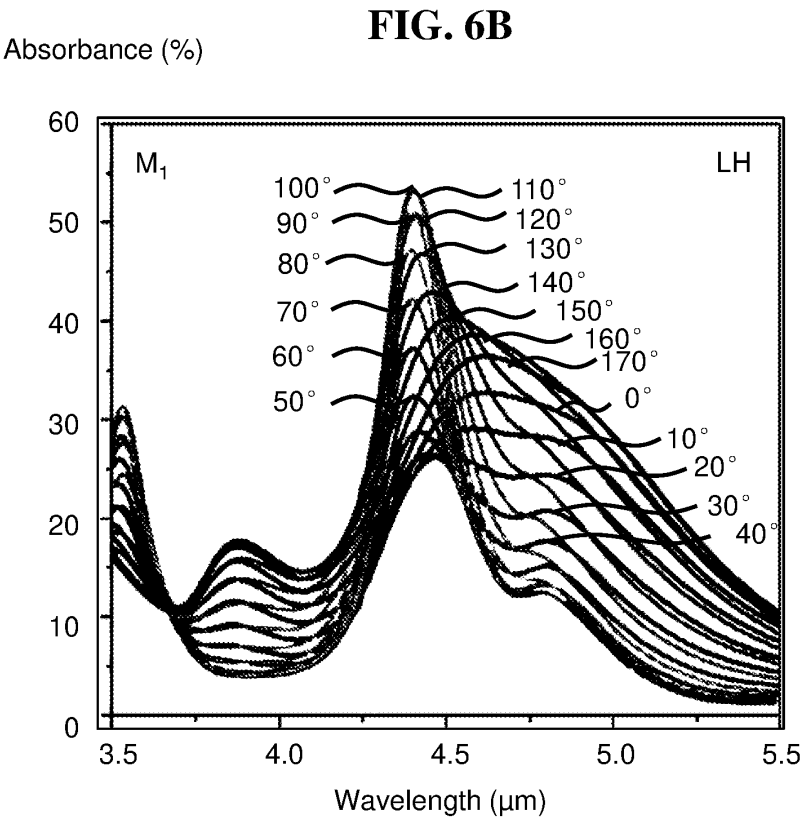


FIG. 6C

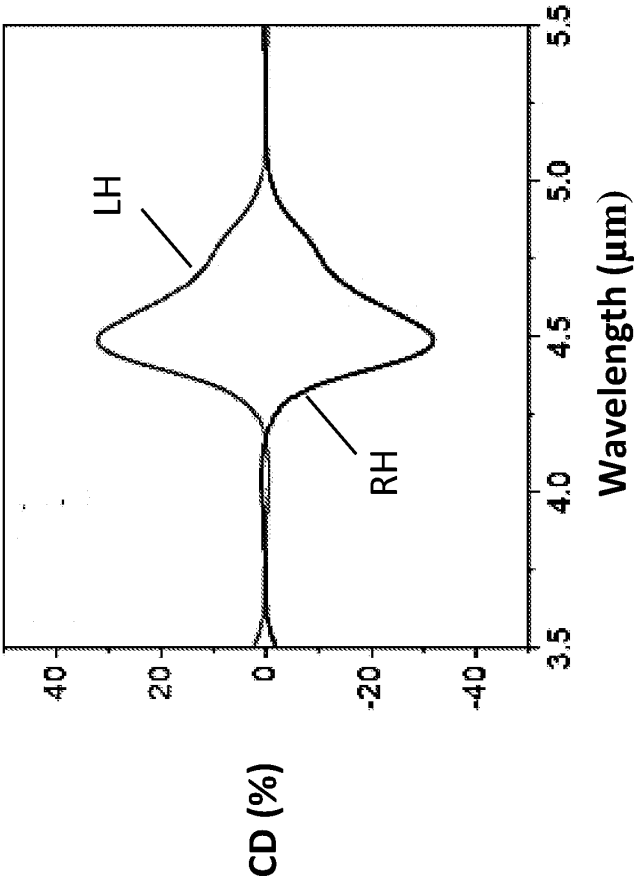


FIG. 6D

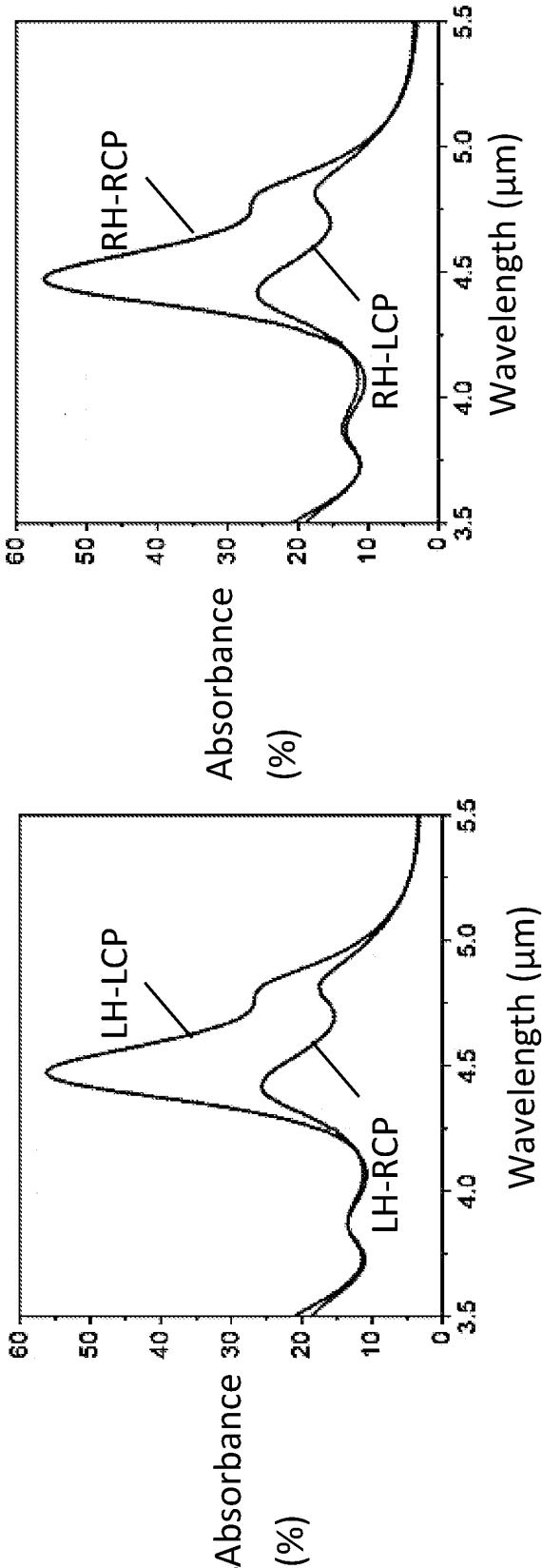


FIG. 7A

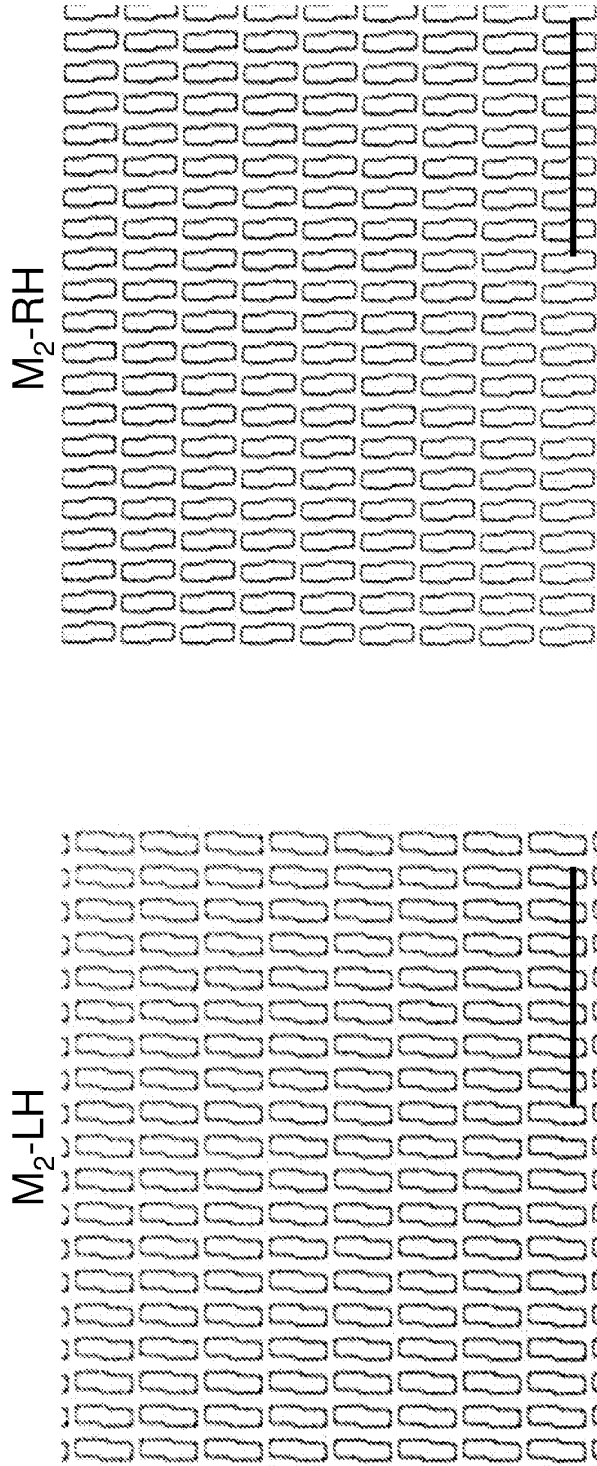


FIG. 7B

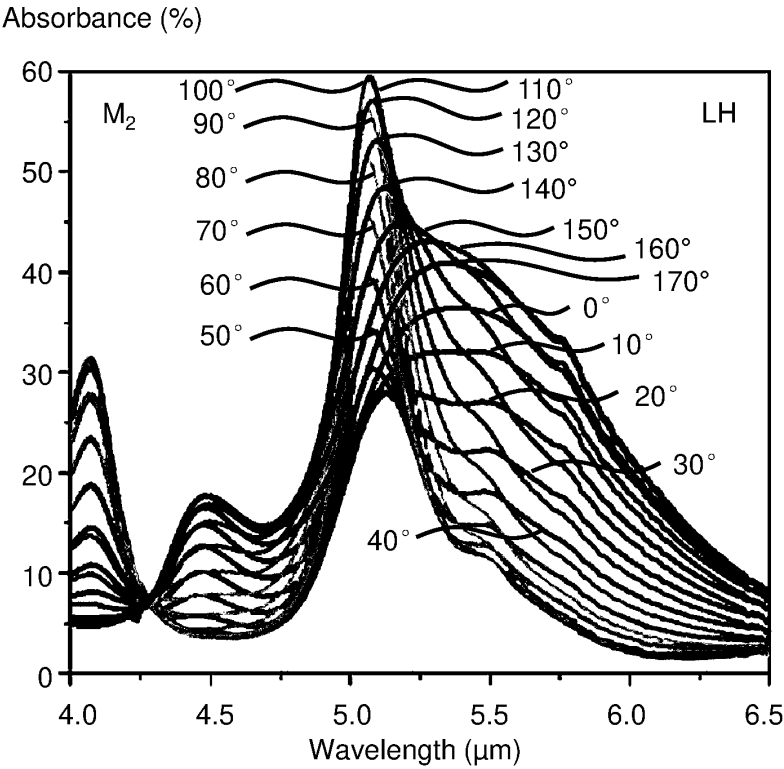


FIG. 7C

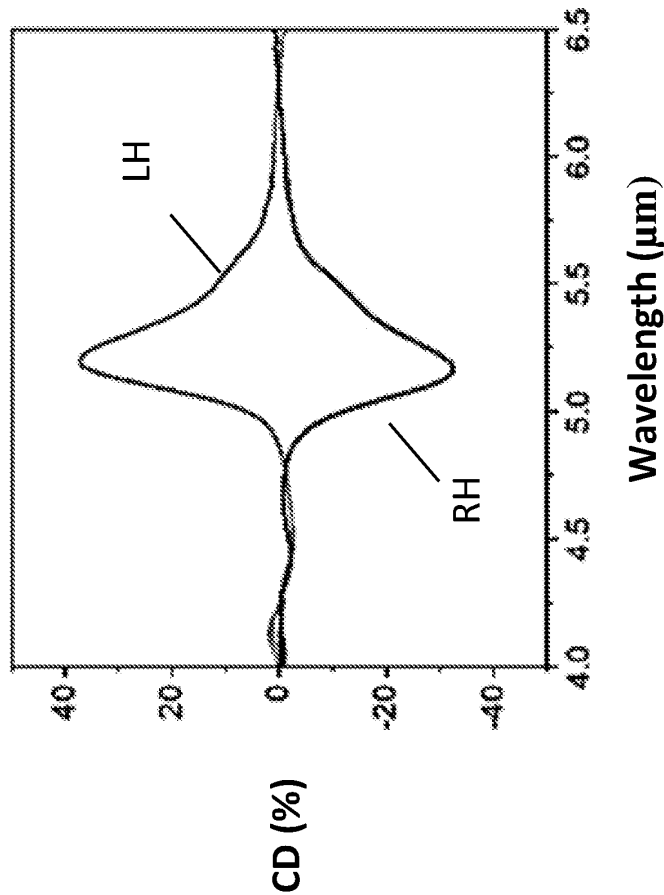


FIG. 7D

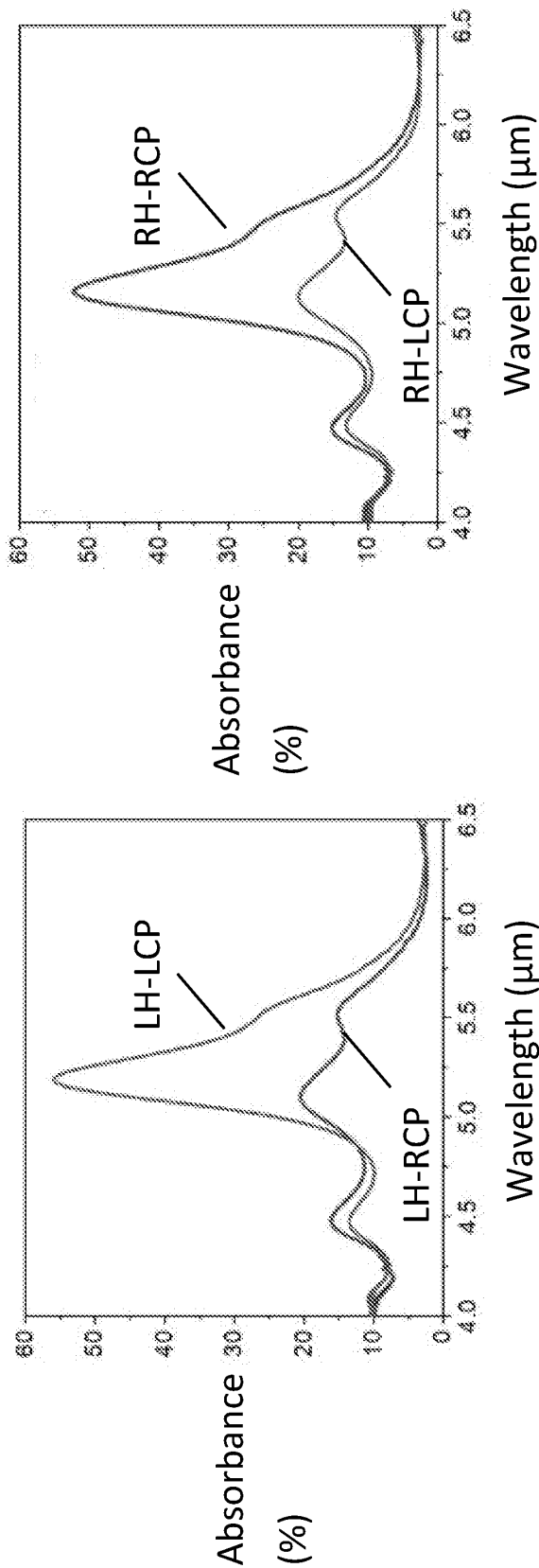


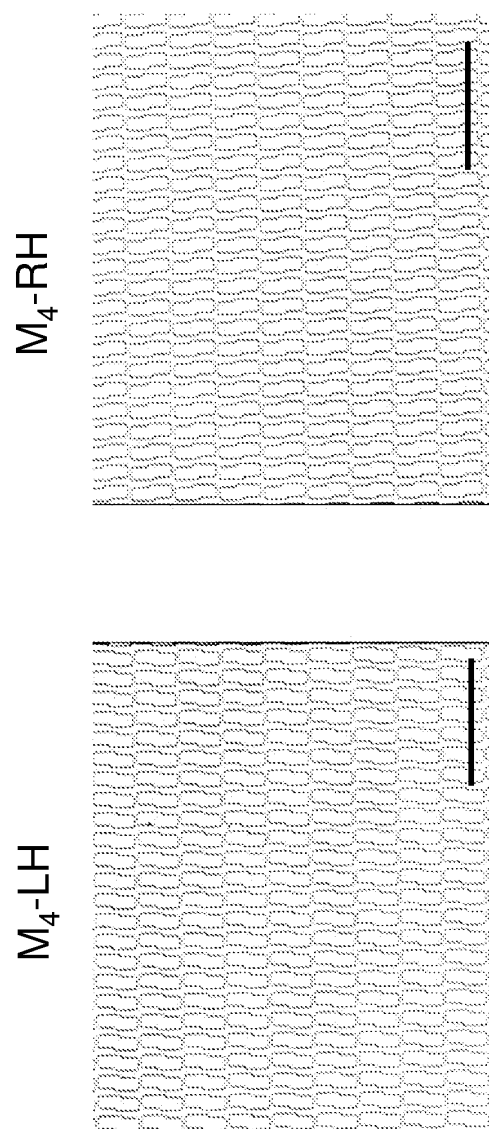
FIG. 8A

FIG. 8B

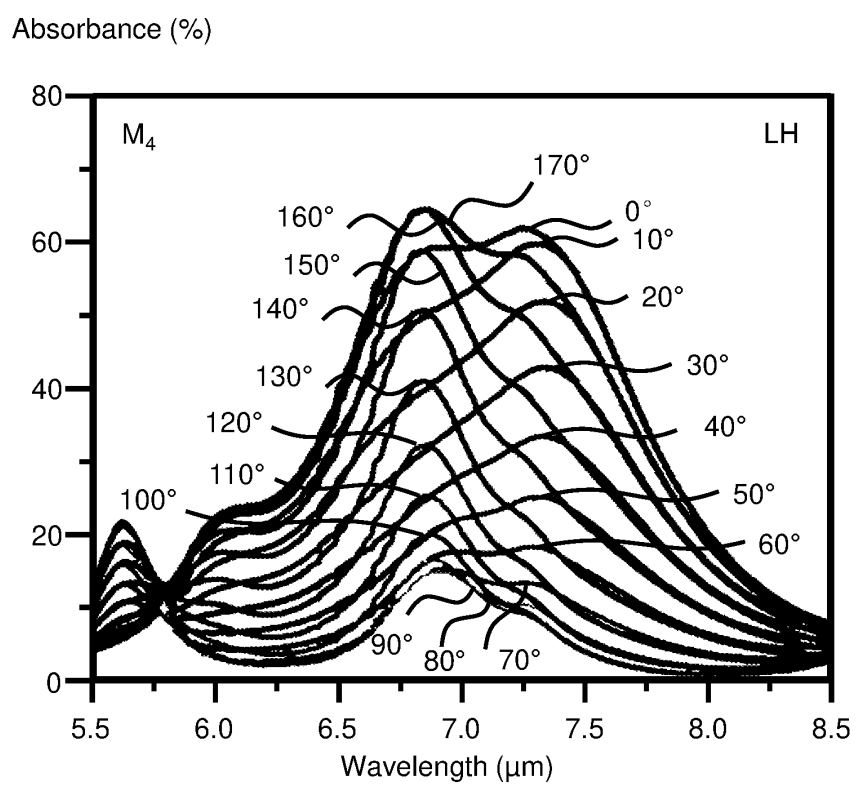


FIG. 8C

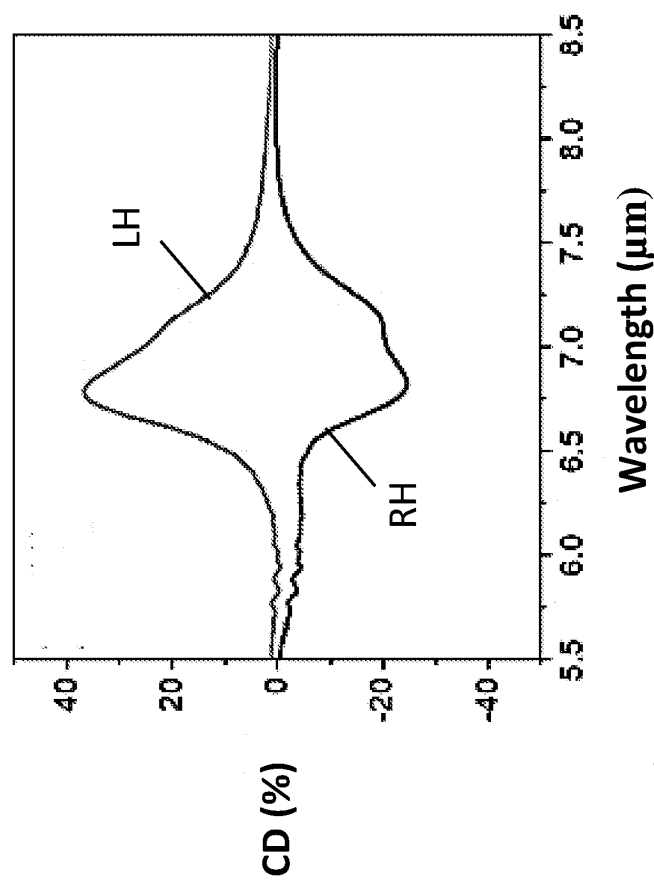


FIG. 8D

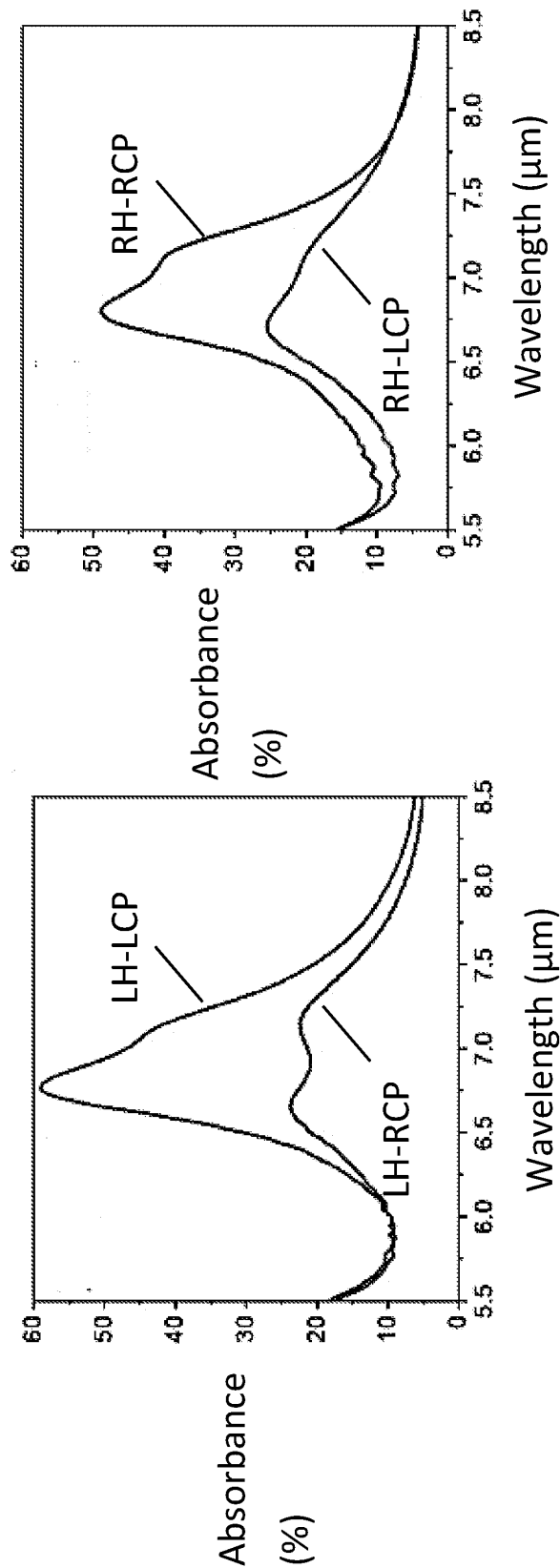


FIG. 9A

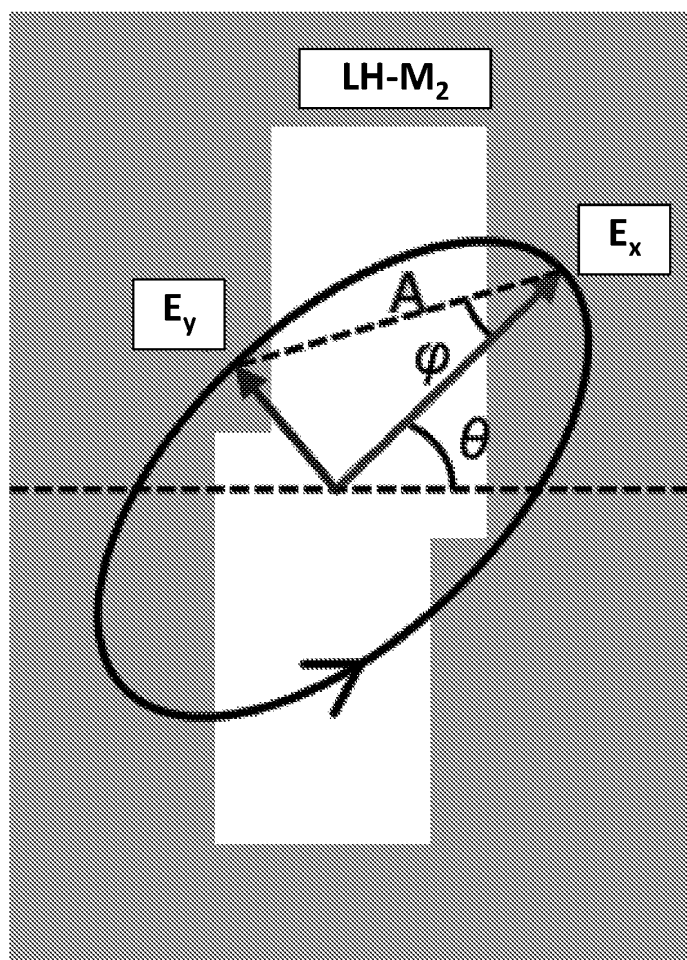


FIG. 9B

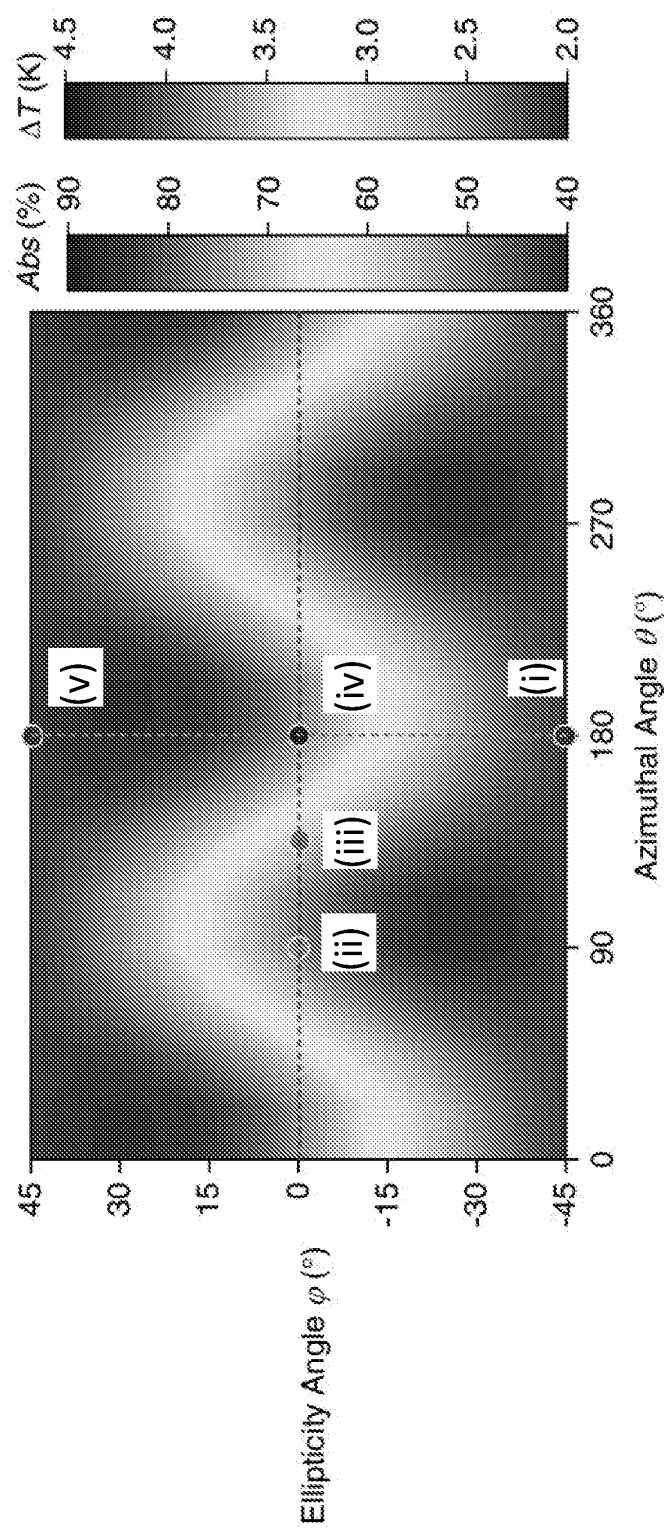


FIG. 9C

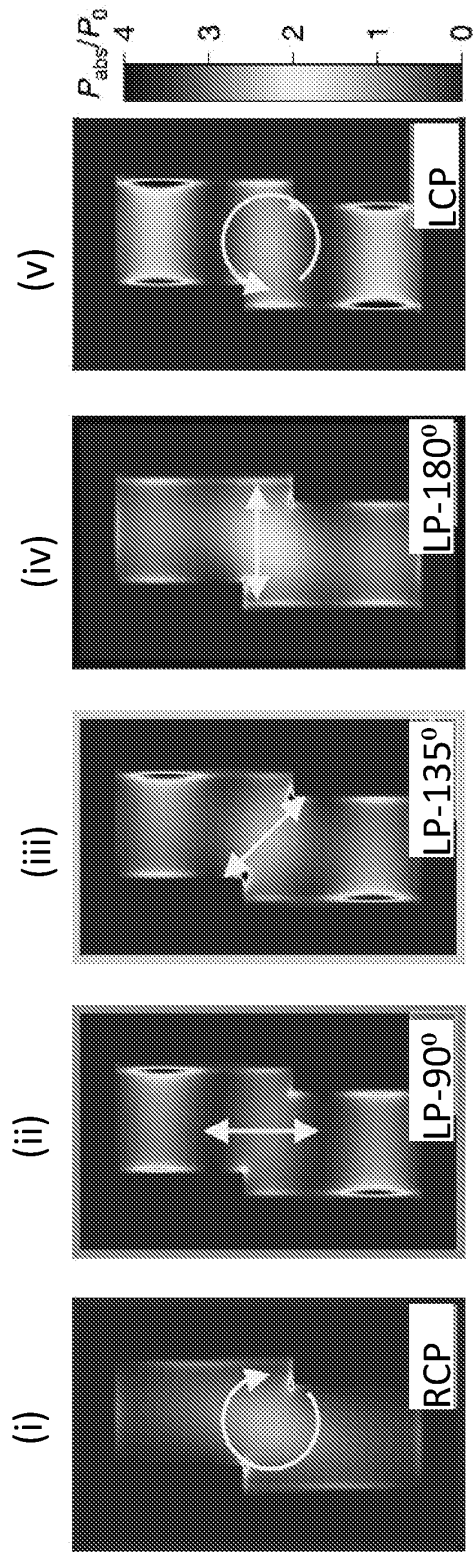


FIG. 9D

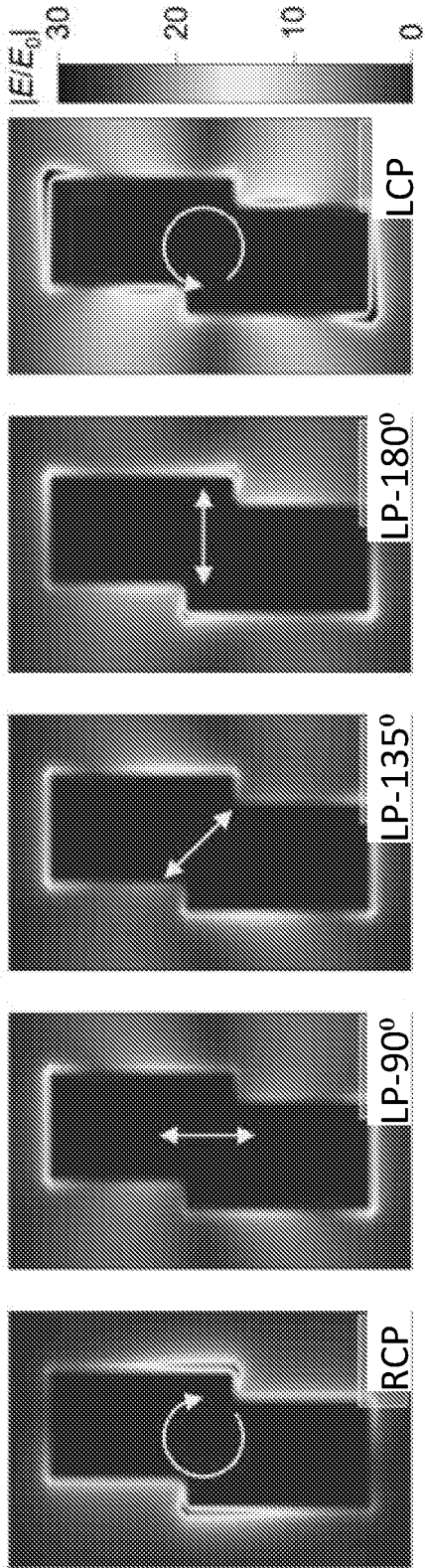


FIG. 9E

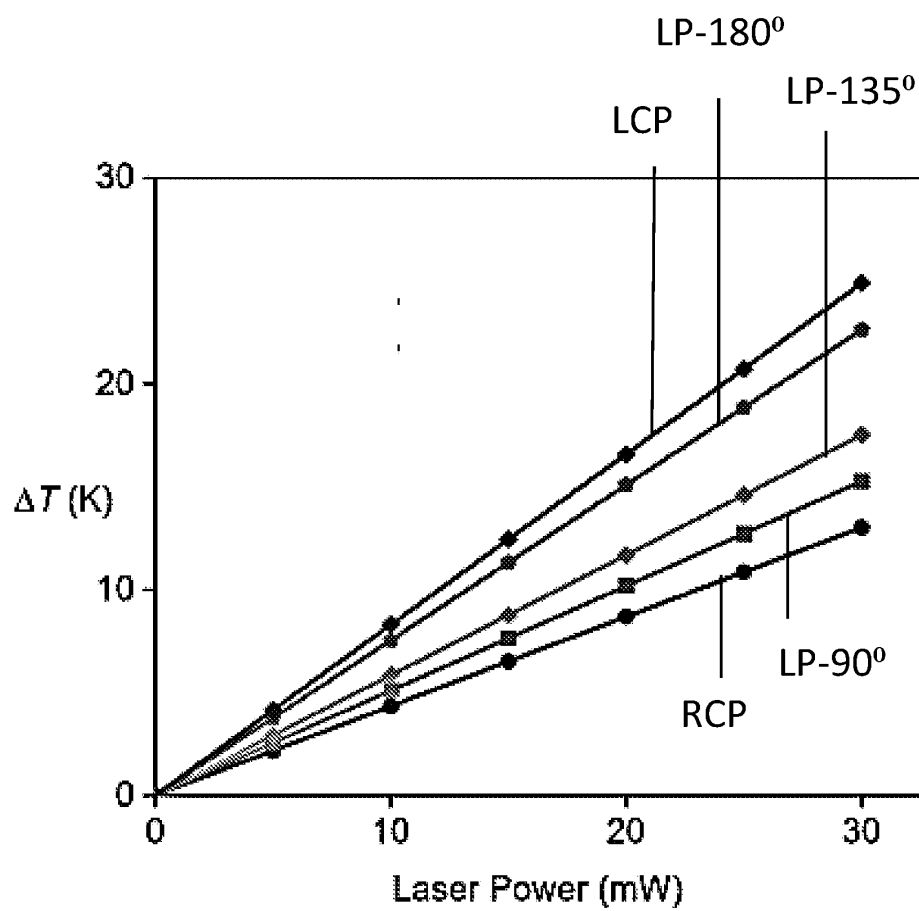


FIG. 9F

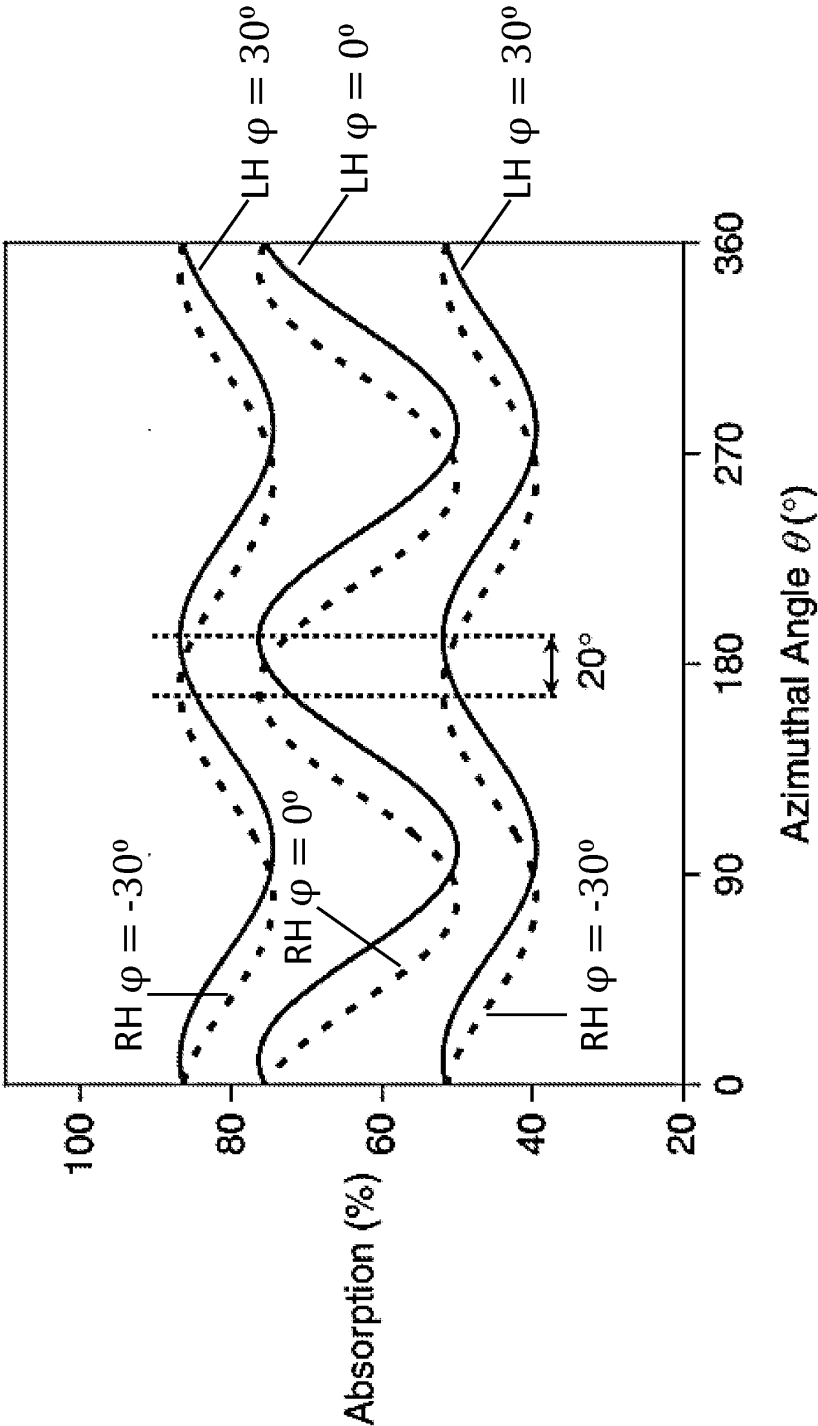


FIG. 9G

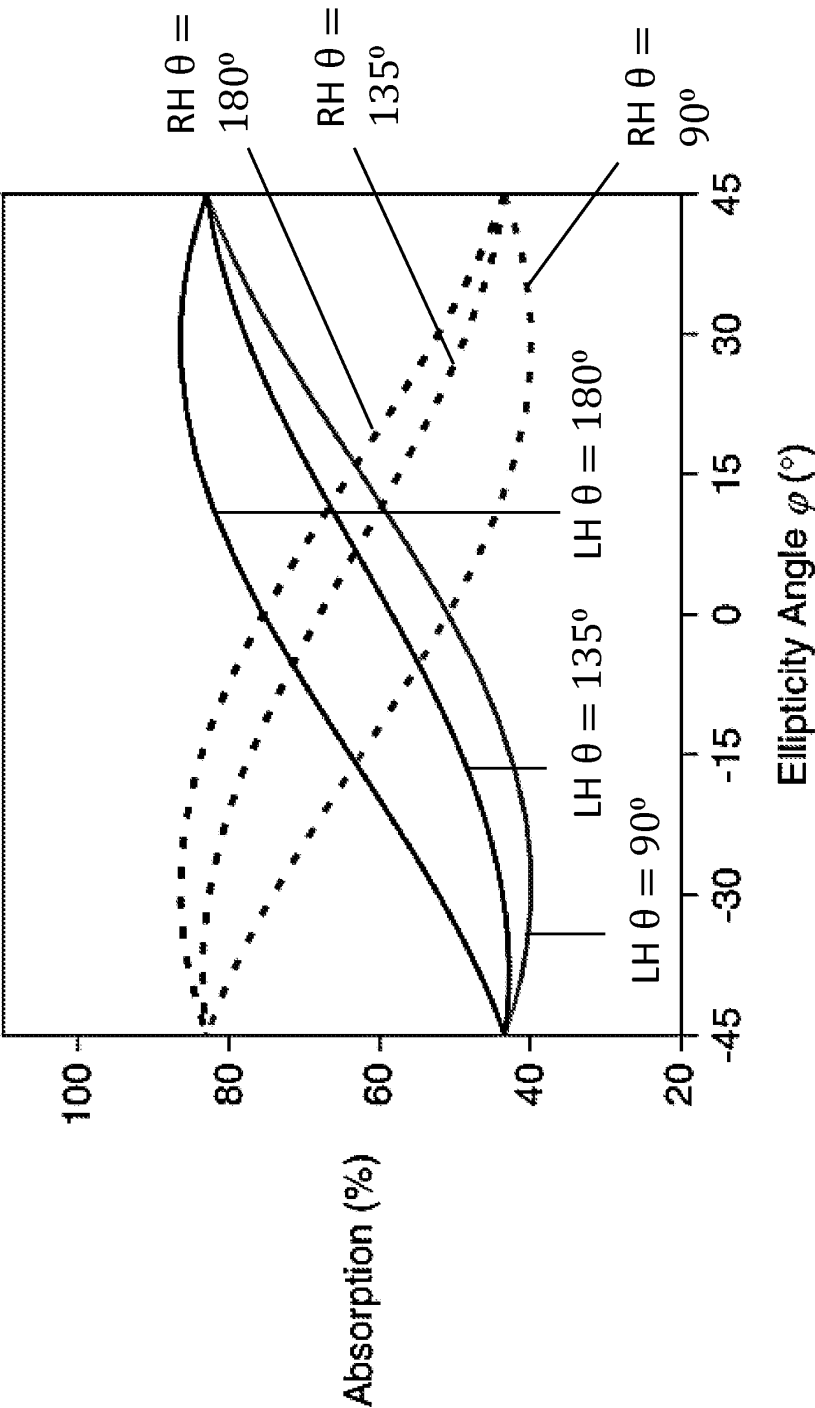


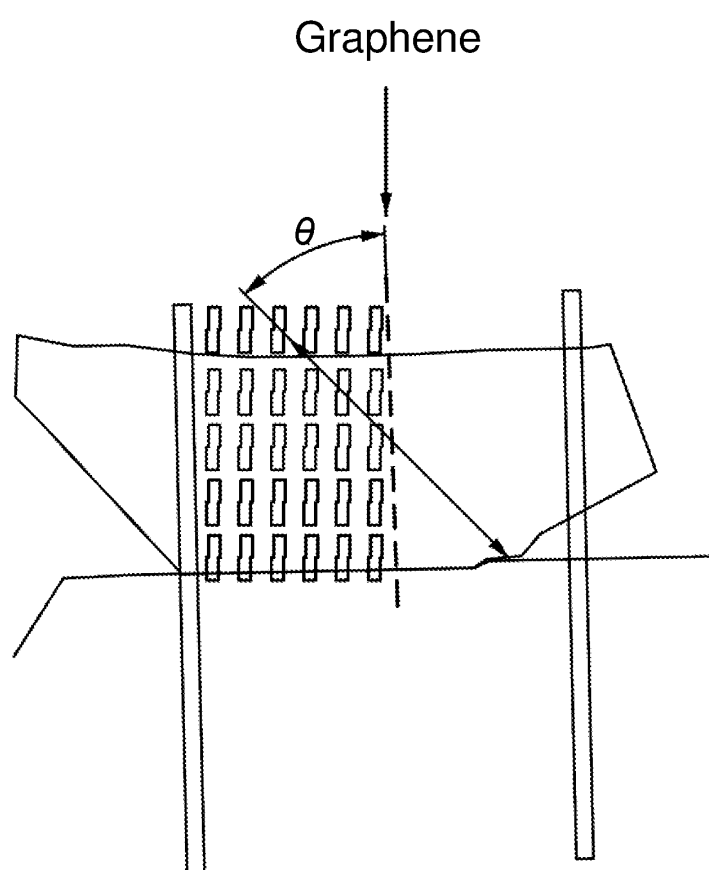
FIG. 10A

FIG. 10B

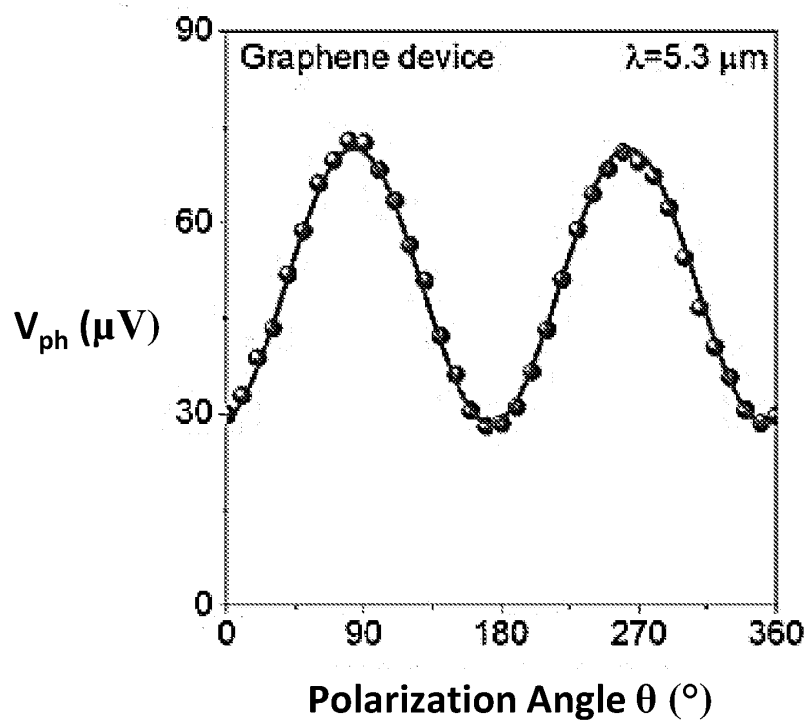


FIG. 10C

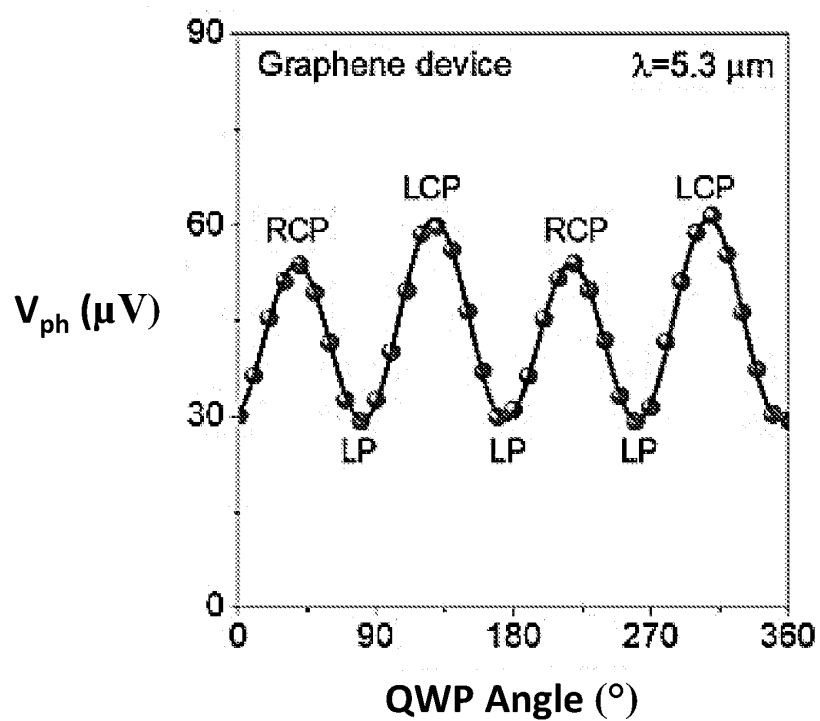


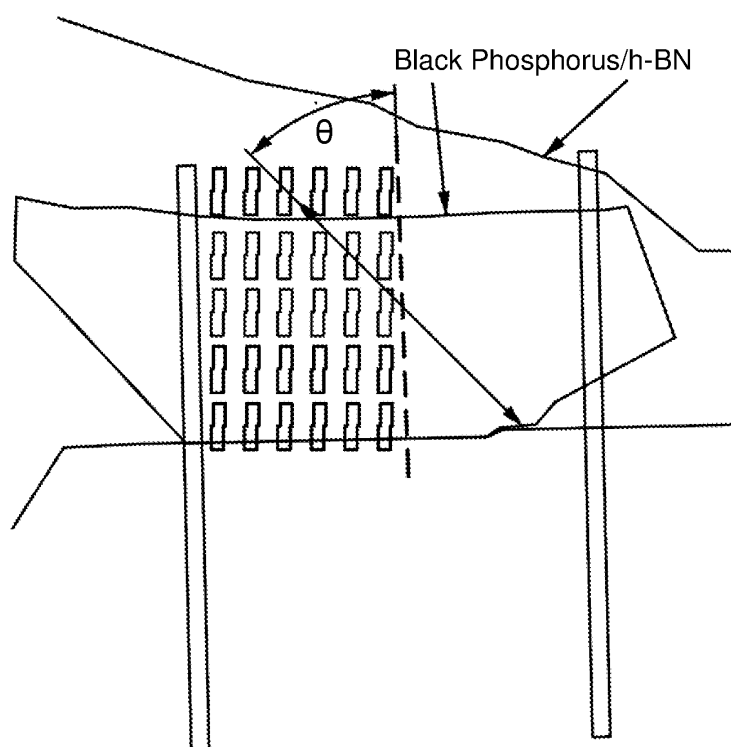
FIG. 11A

FIG. 11B

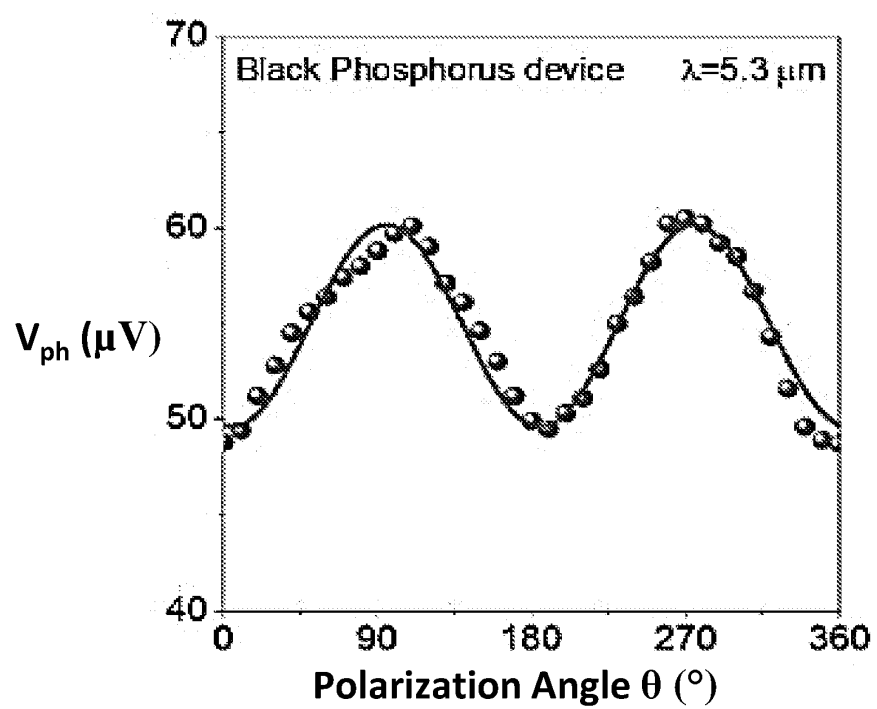


FIG. 11C

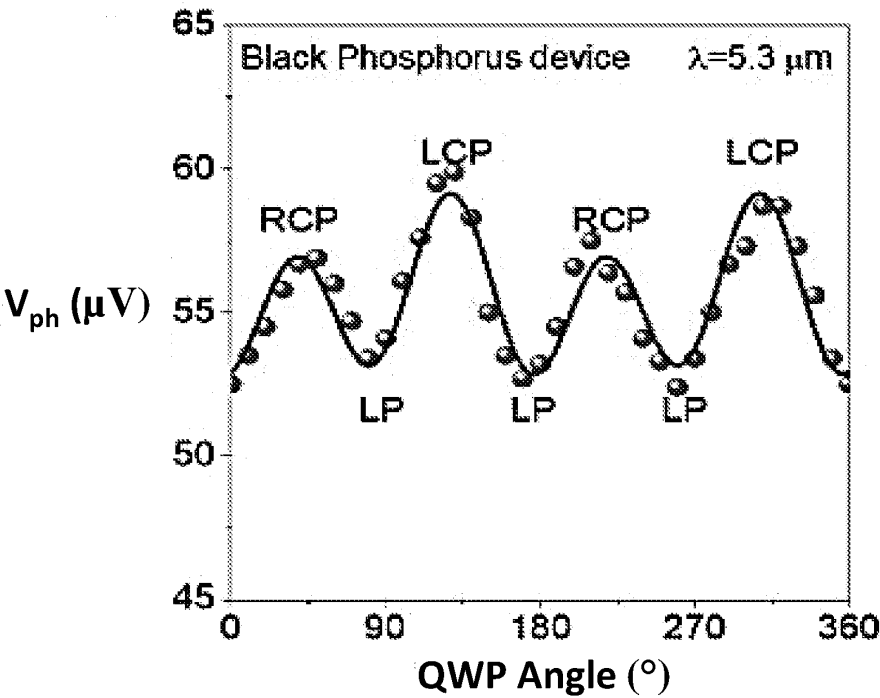


FIG. 12A

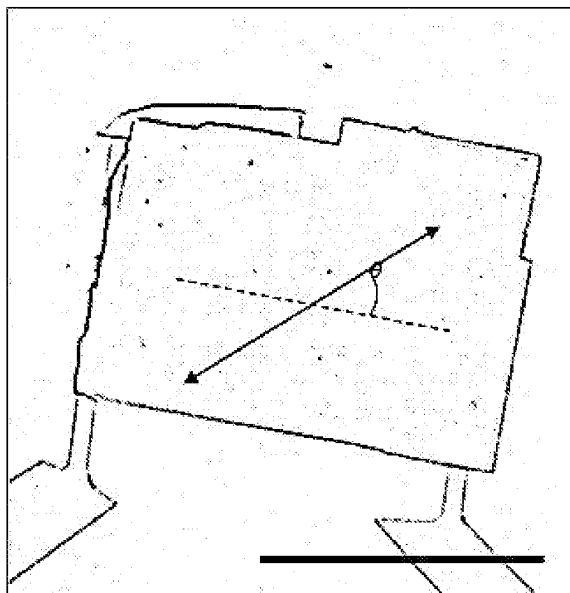


FIG. 12B

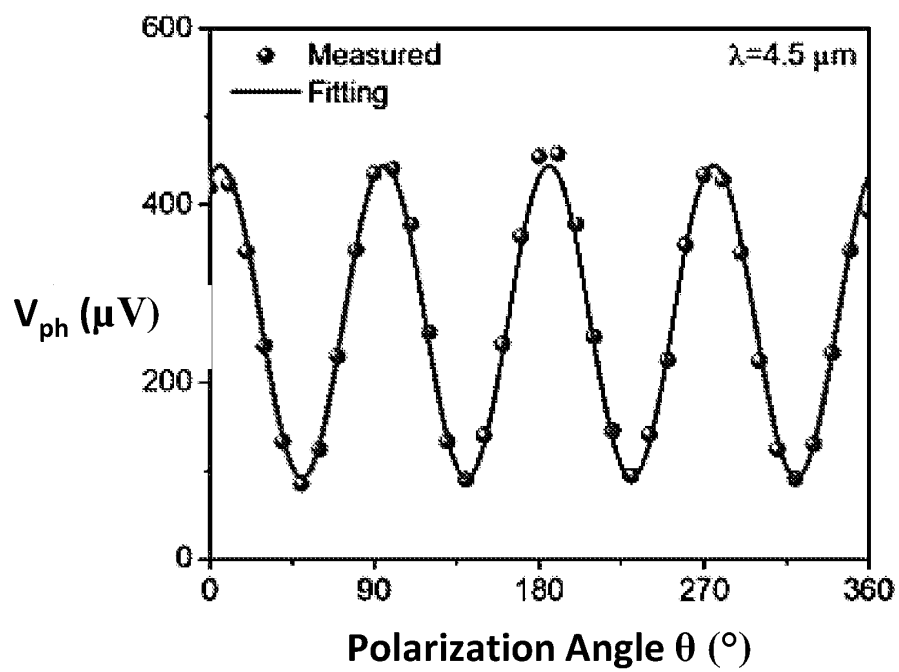


FIG. 12C

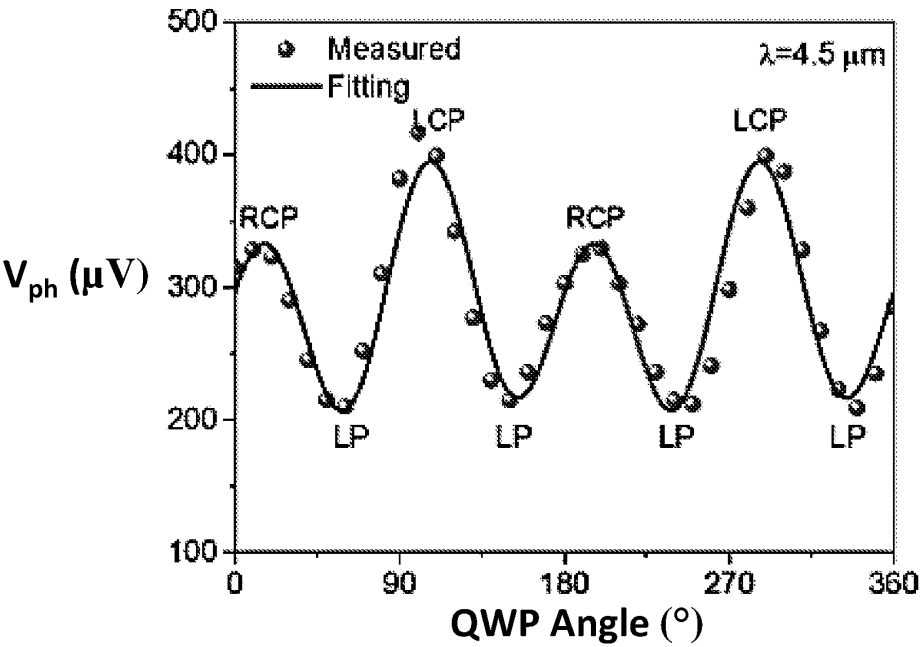


FIG. 12D

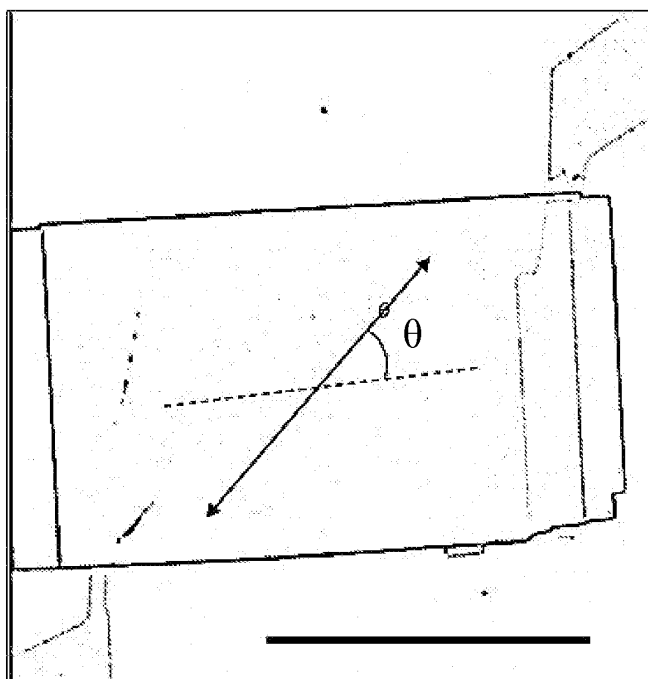


FIG. 12E

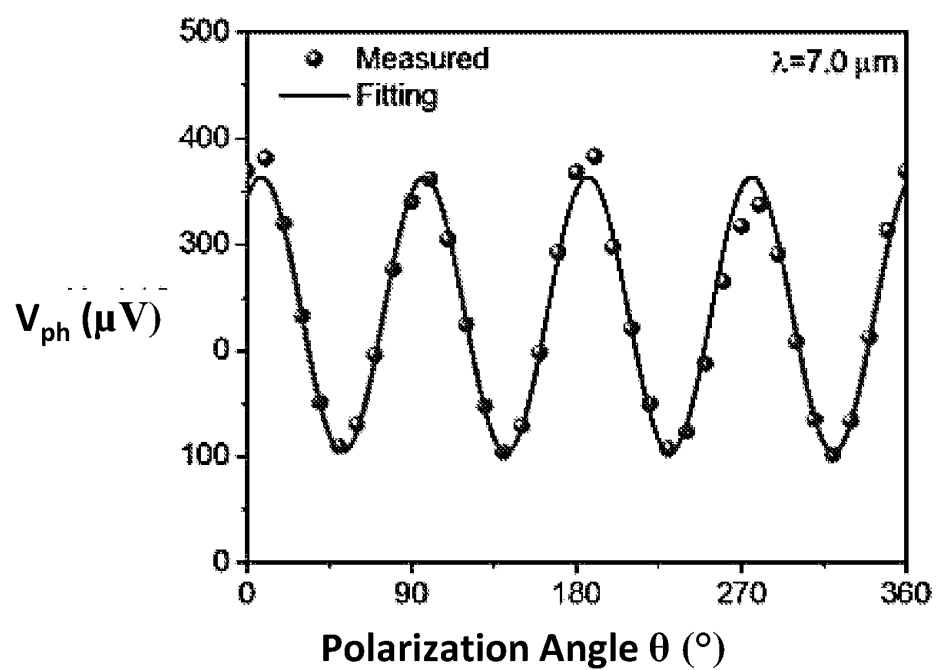


FIG. 12F

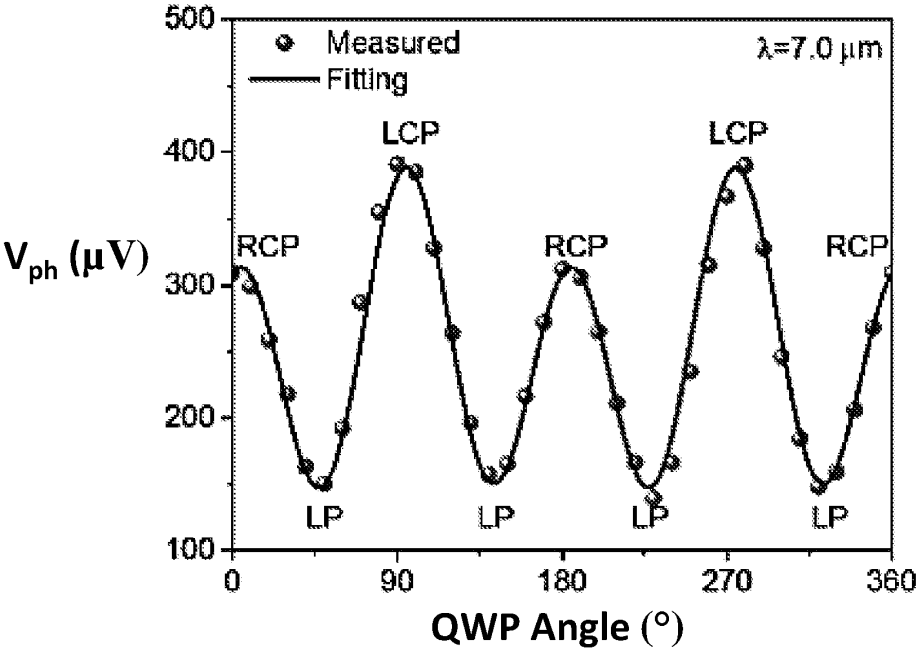


FIG. 13A

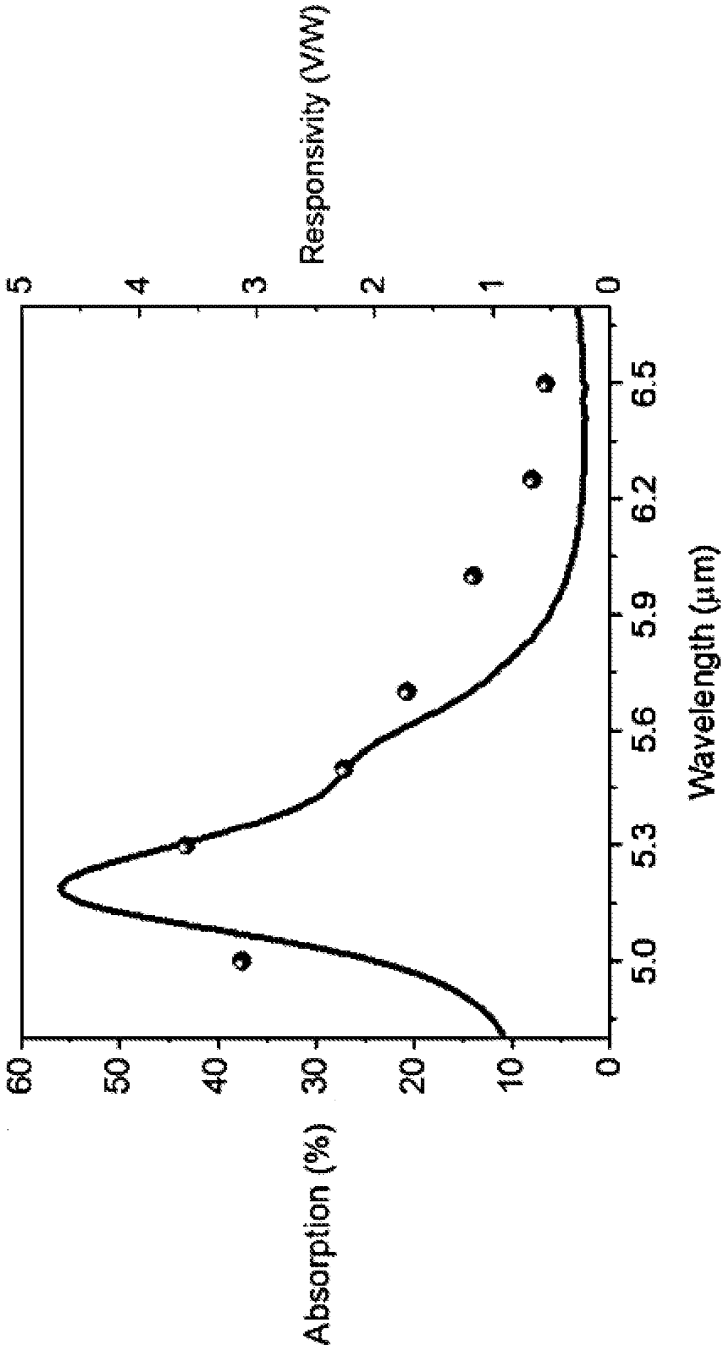


FIG. 13B

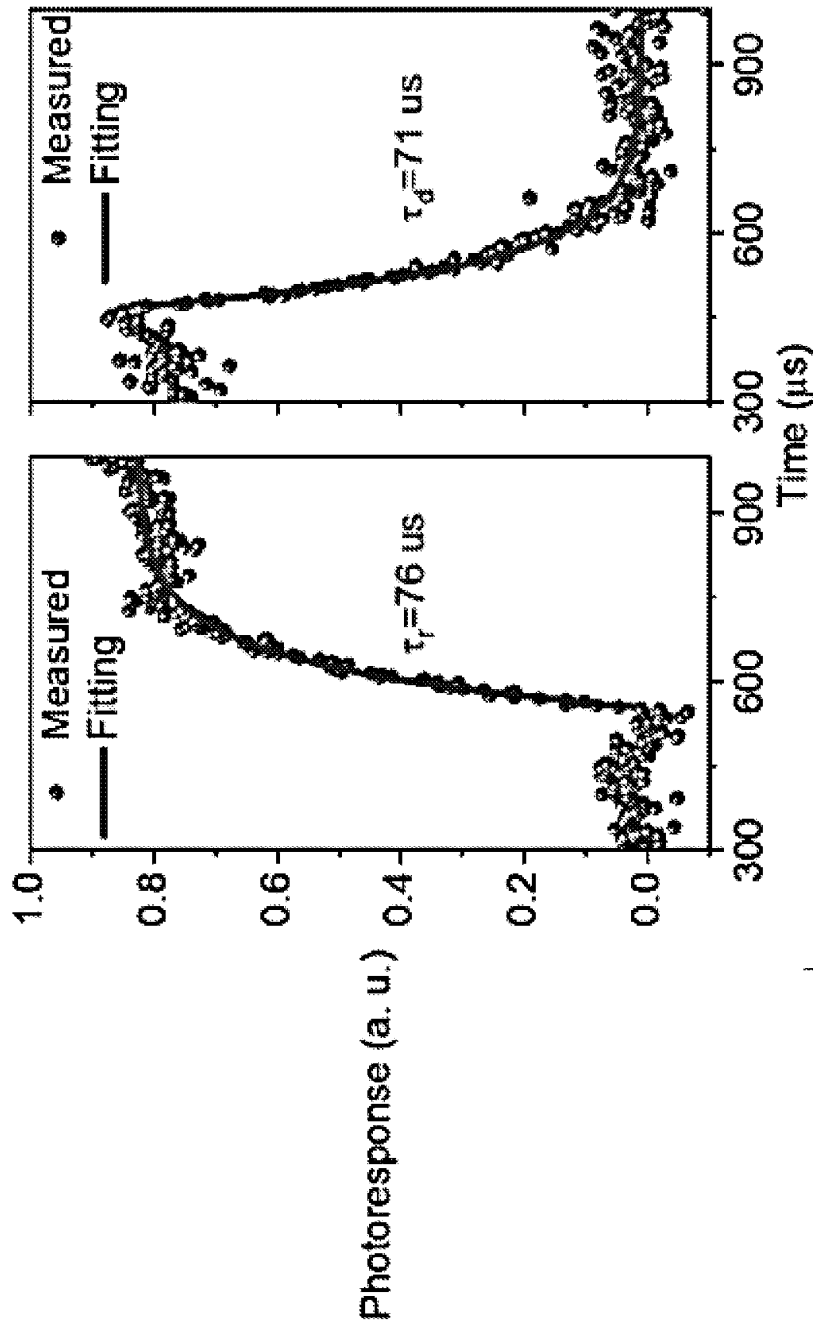


FIG. 13C

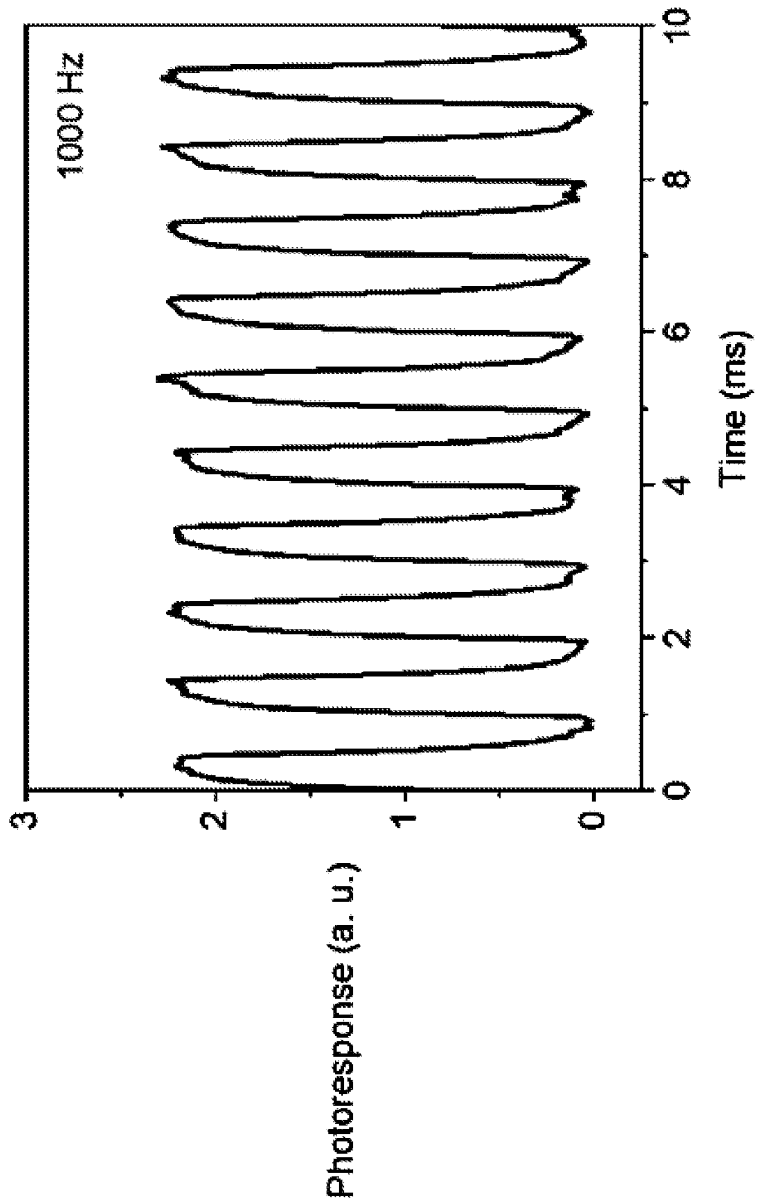


FIG. 13D

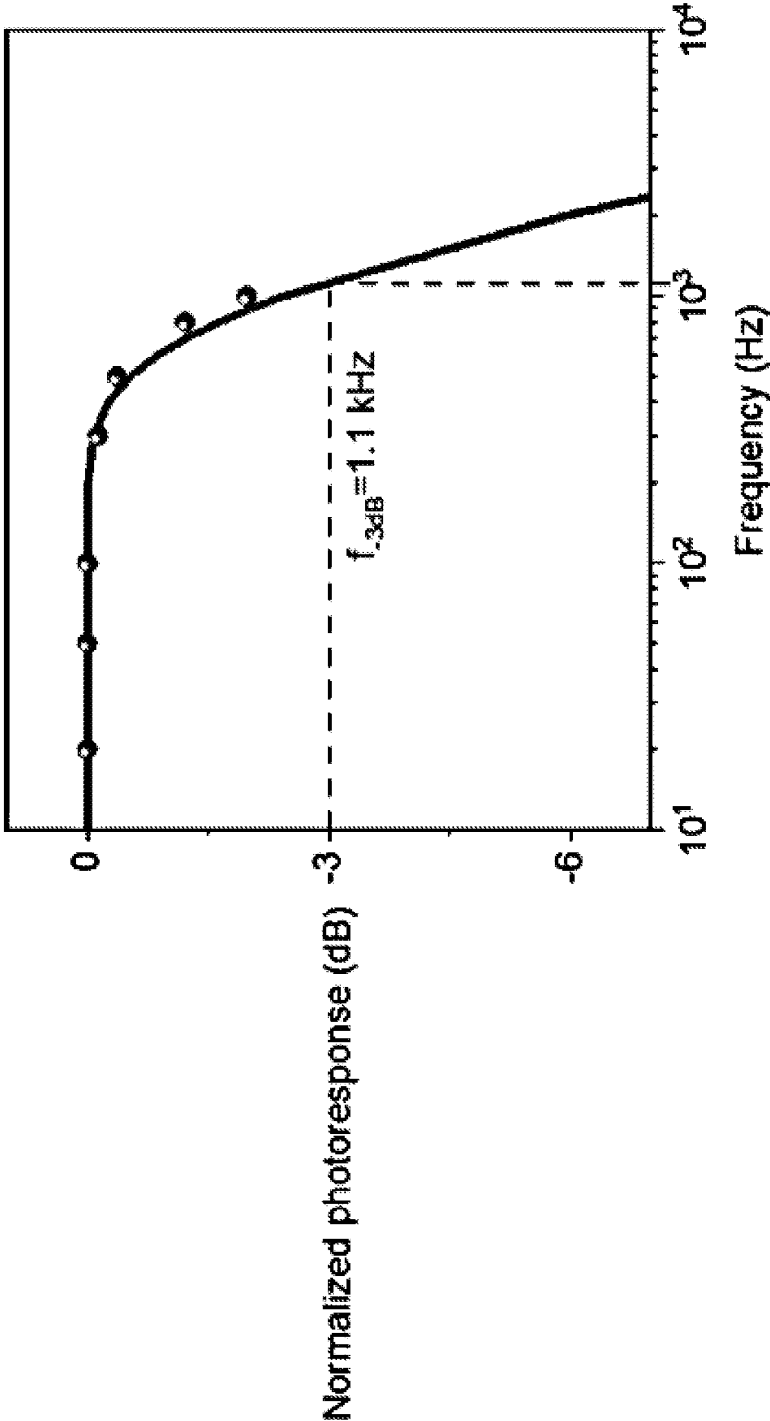


FIG. 13E

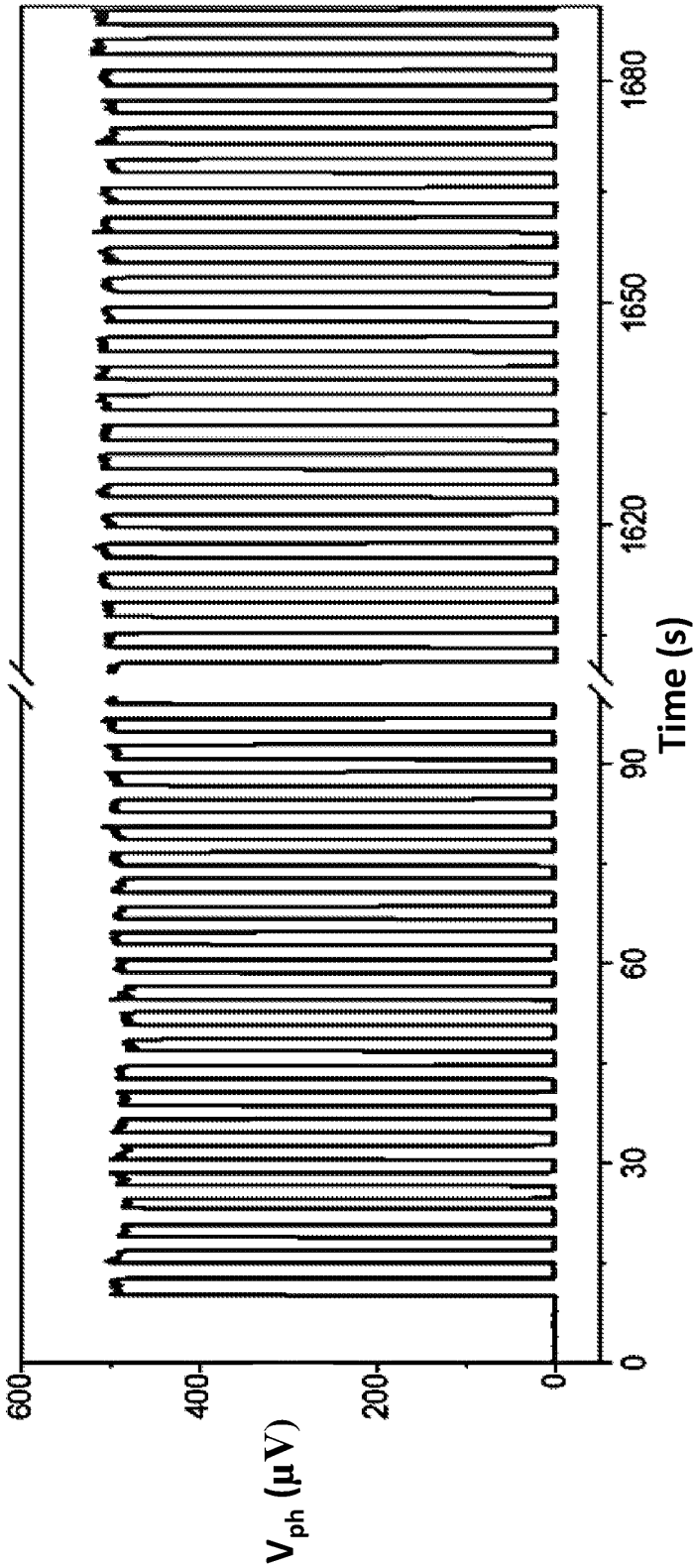


FIG. 14A

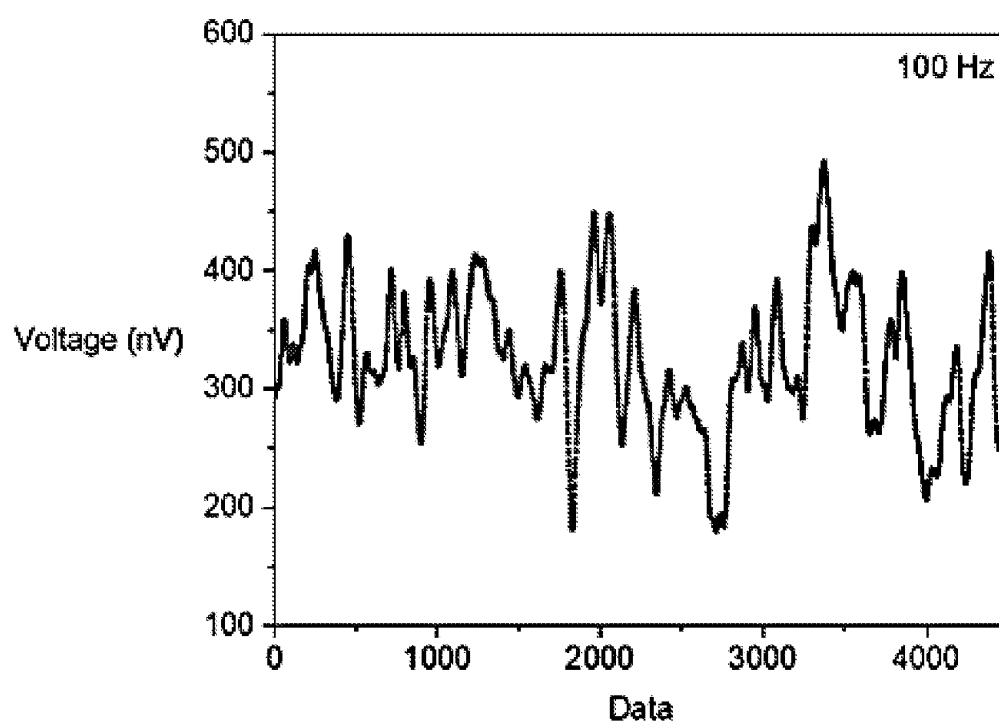


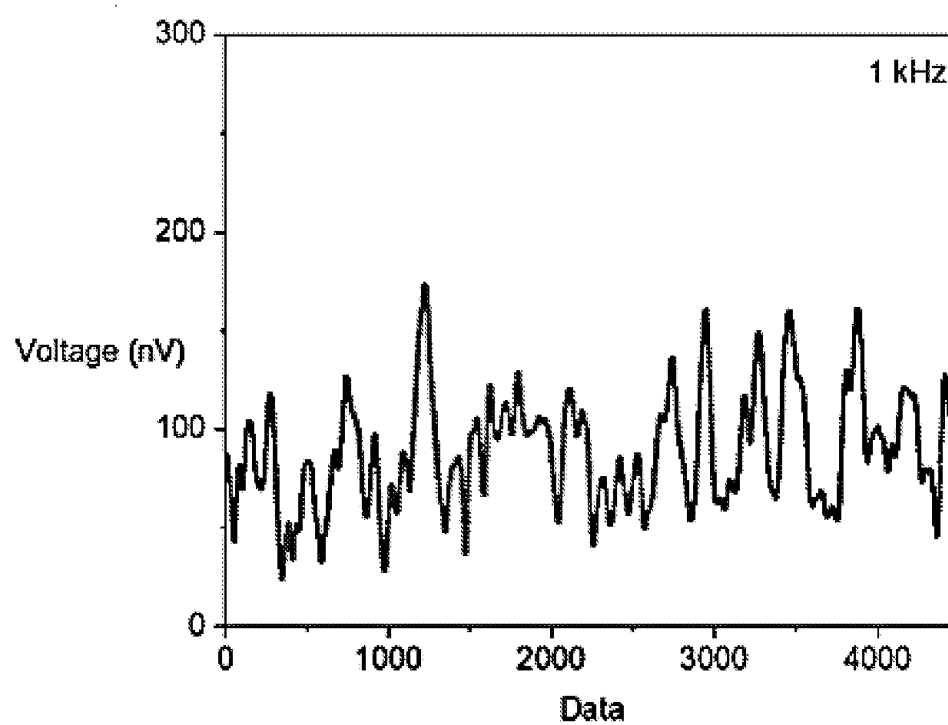
FIG. 14B

FIG. 14C

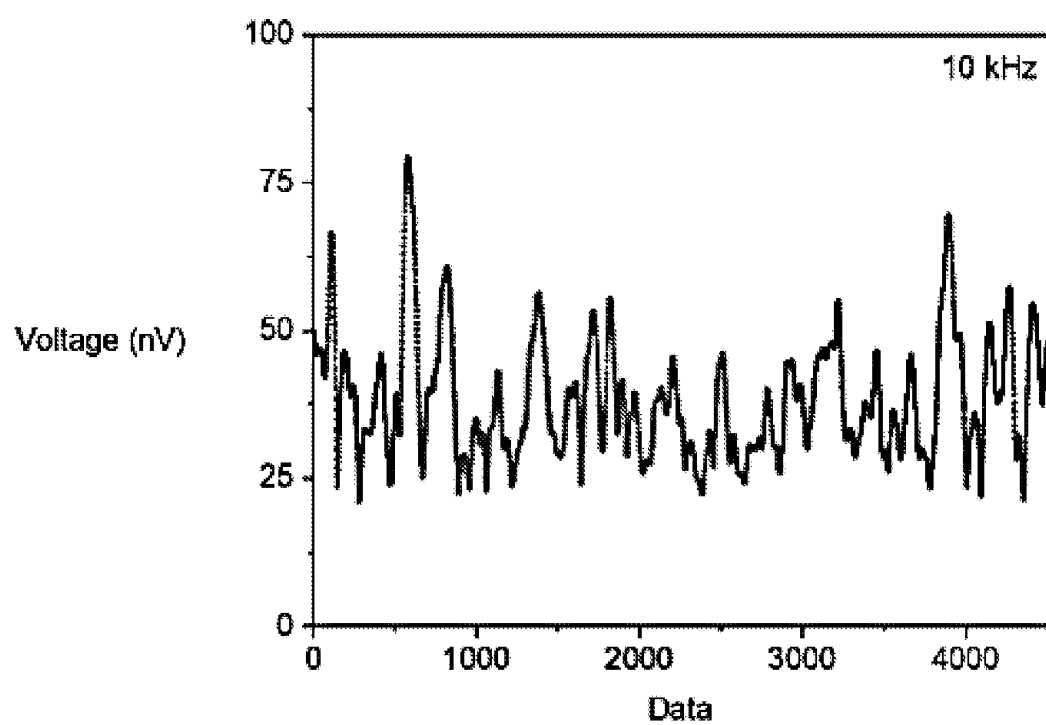


FIG. 14D

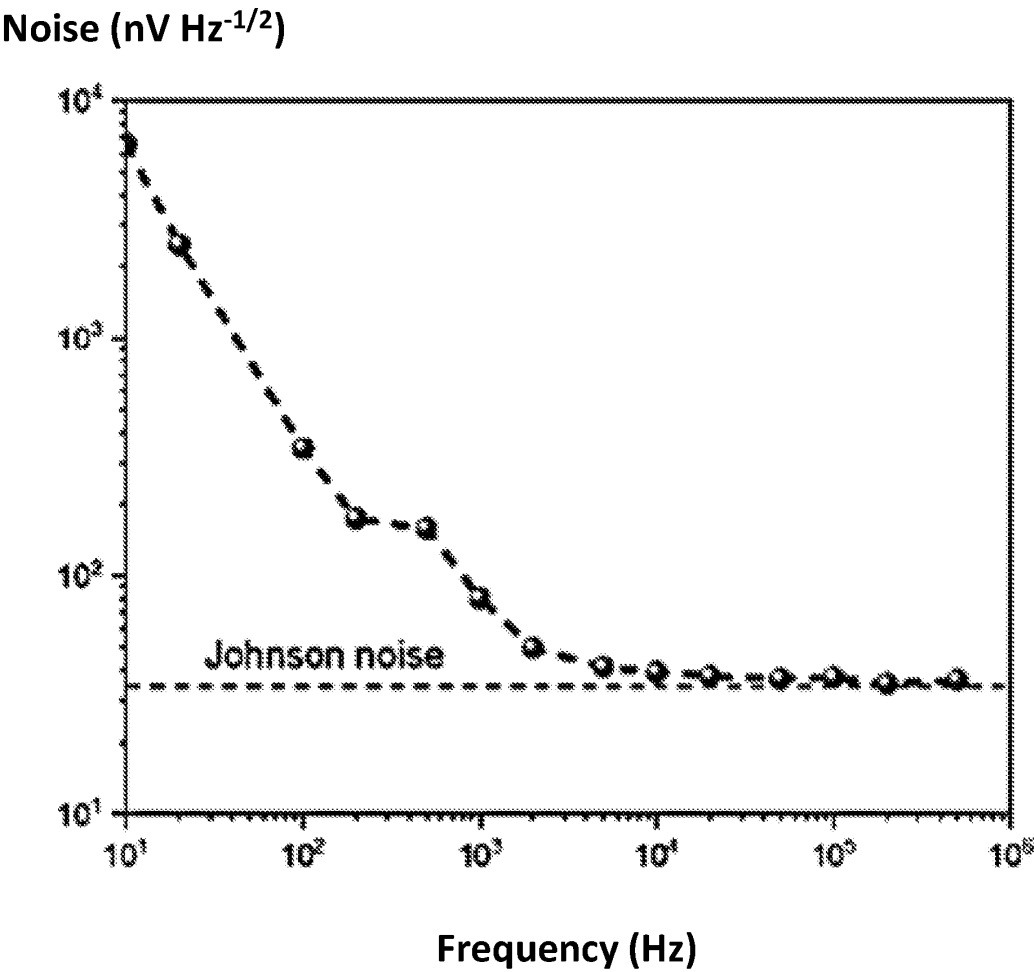


FIG. 15A

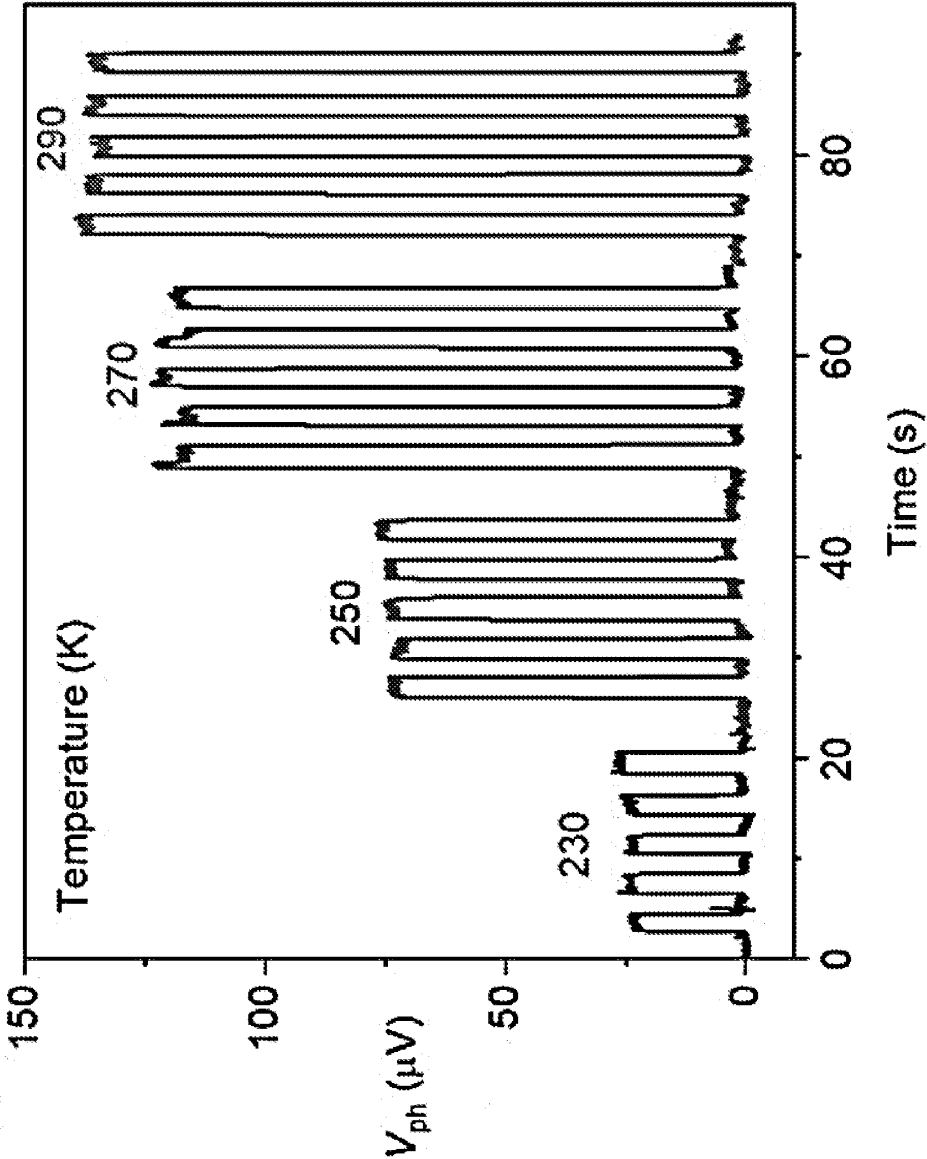


FIG. 15B

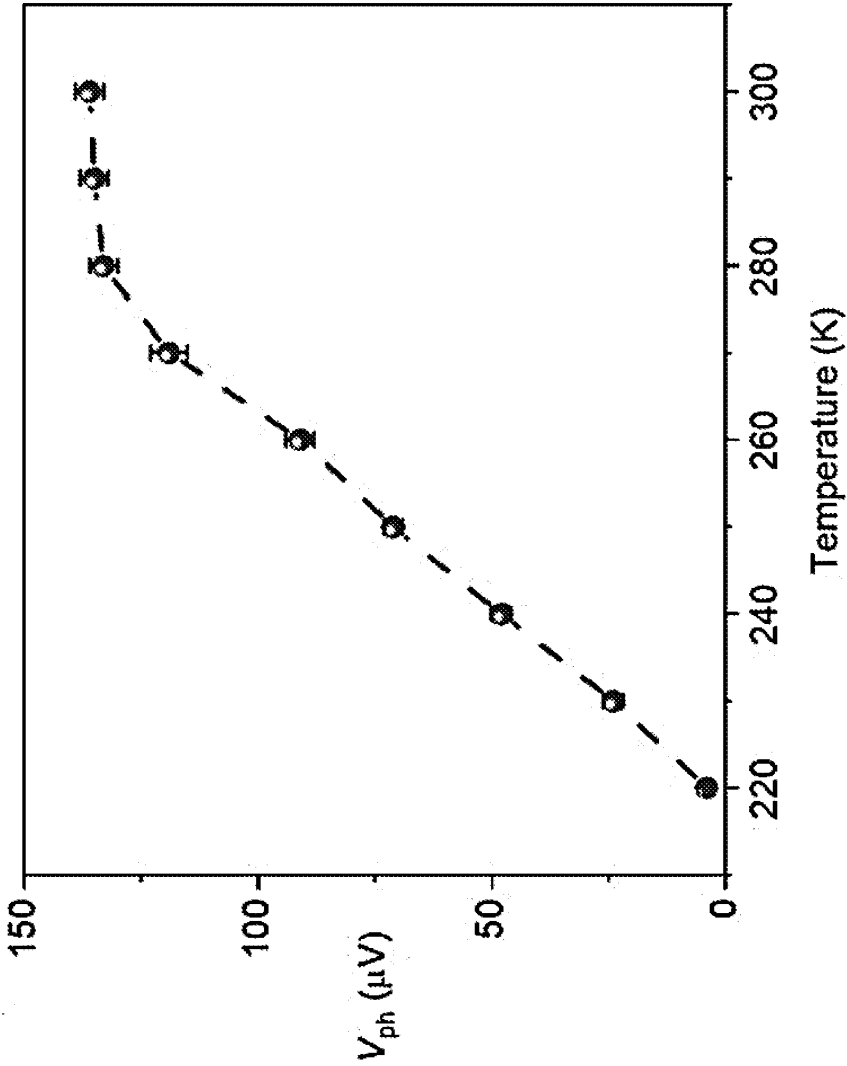
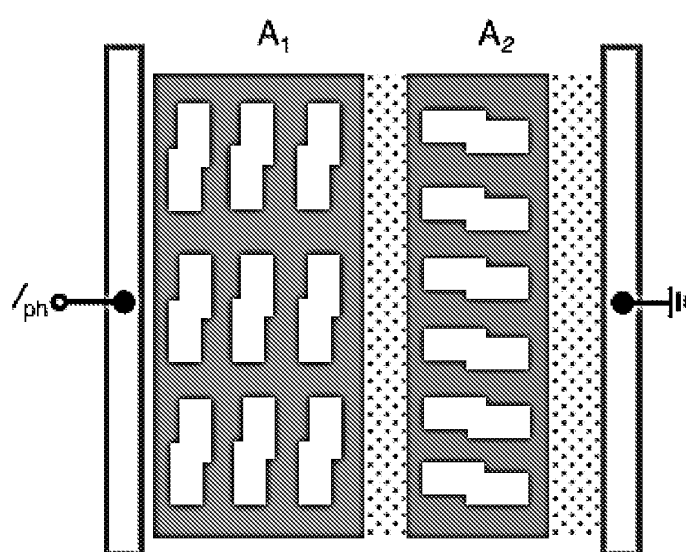


FIG. 16A



$$V_{ph}(A_1, A_2, \theta) = V_{ph}(A_1, \theta) + V_{ph}(A_2, \theta)$$

FIG. 16B

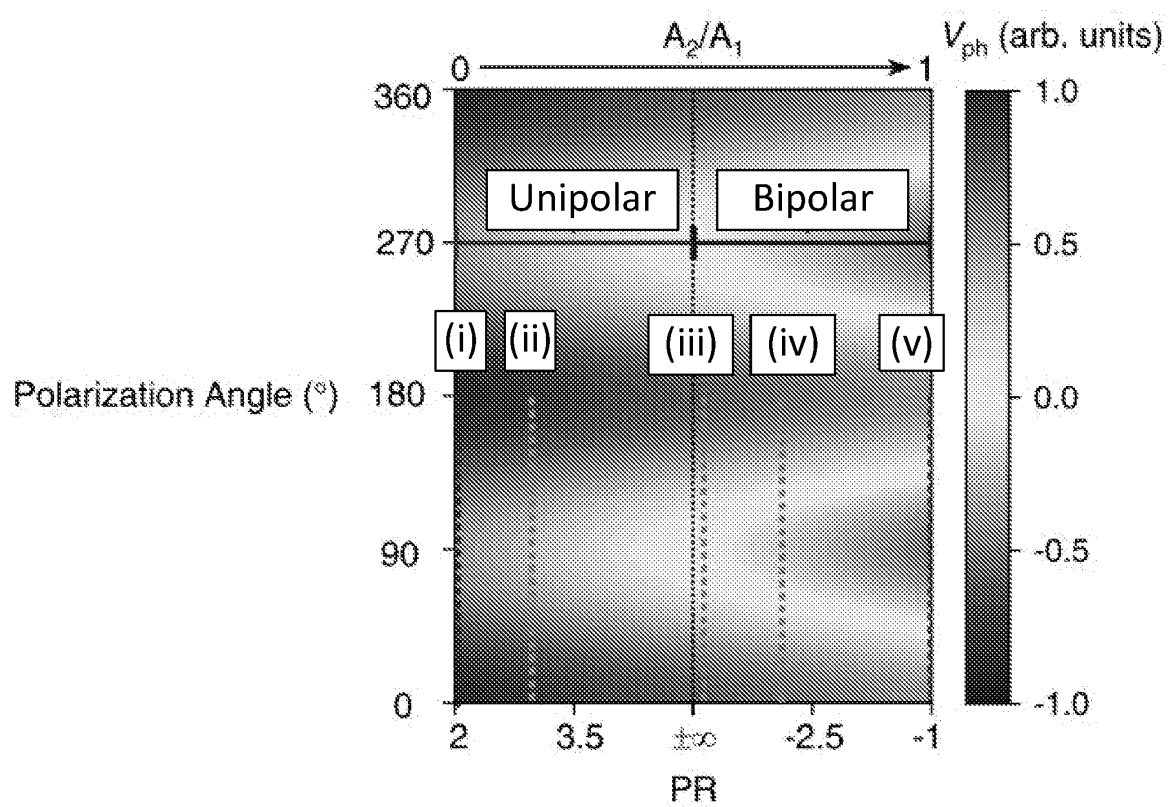


FIG. 16C

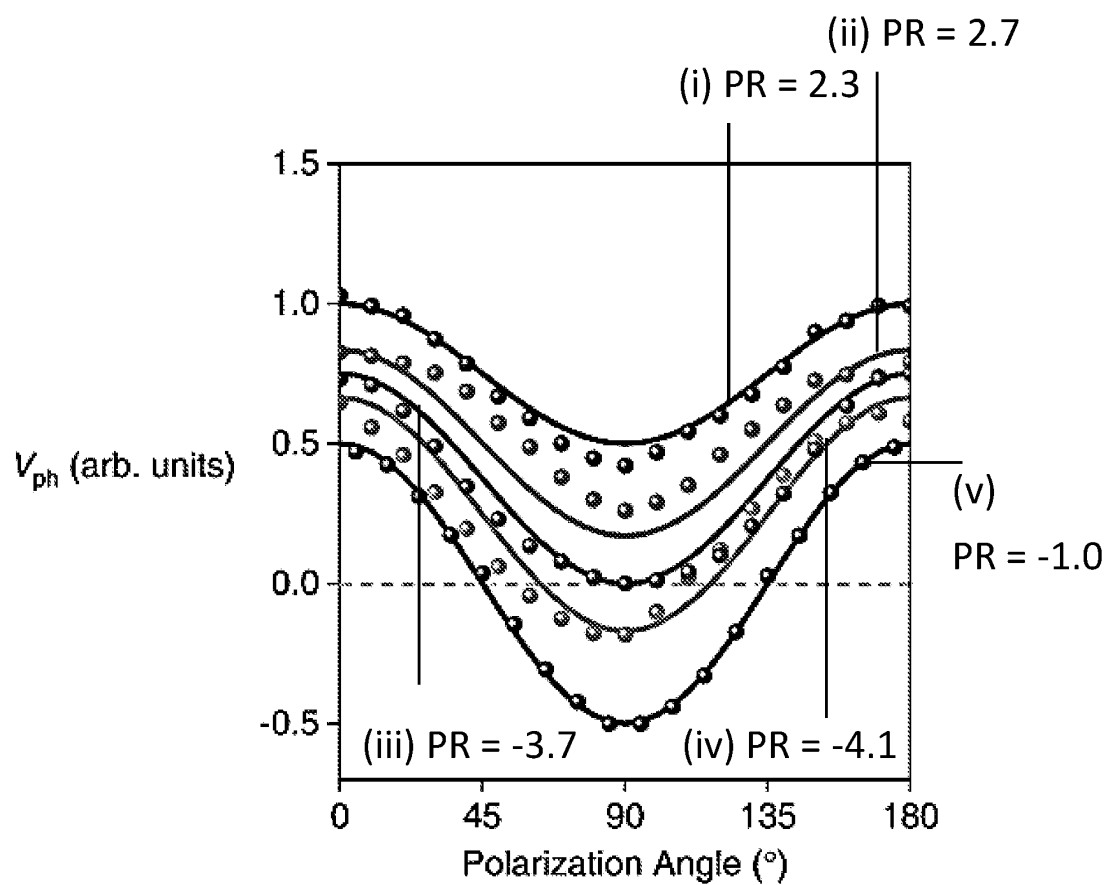


FIG. 17A

$$A_2/A_1=0$$

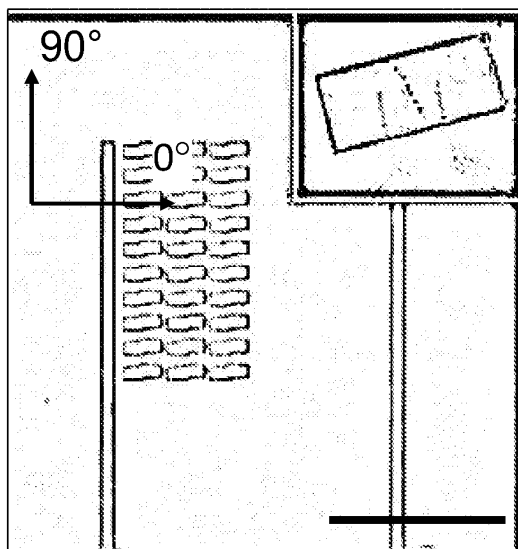


FIG. 17B

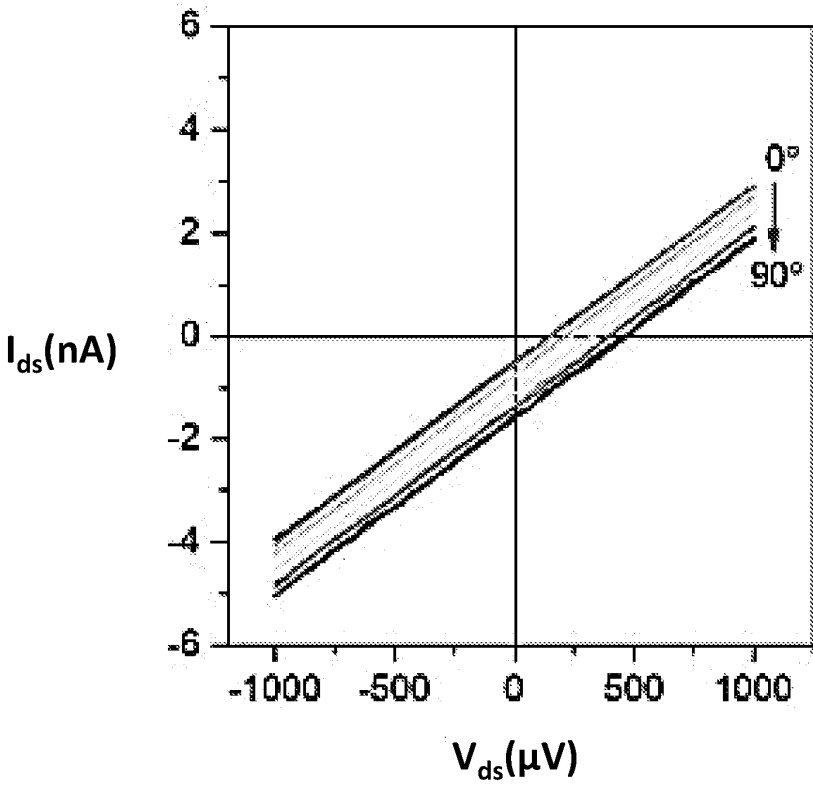


FIG. 17C

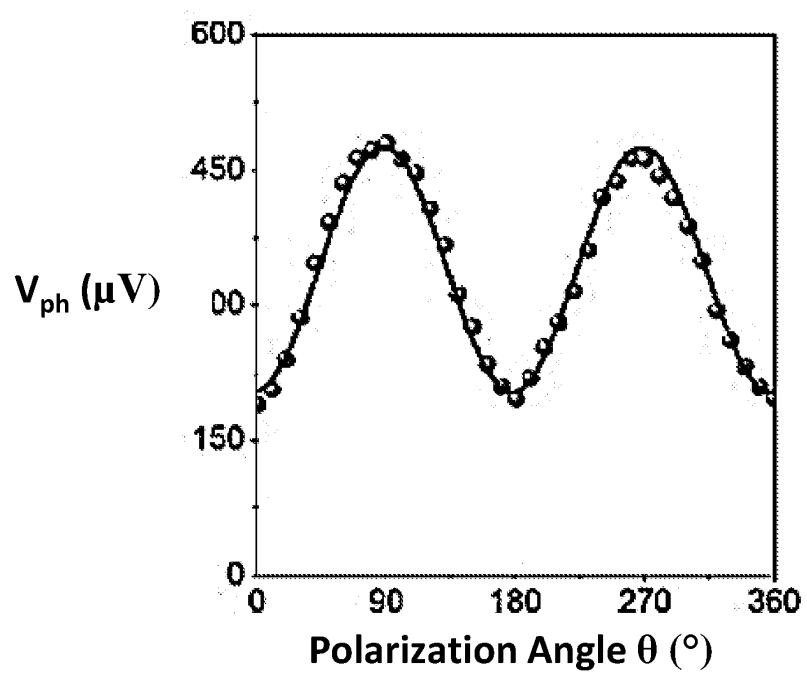


FIG. 18A

$$A_2/A_1=0.33$$

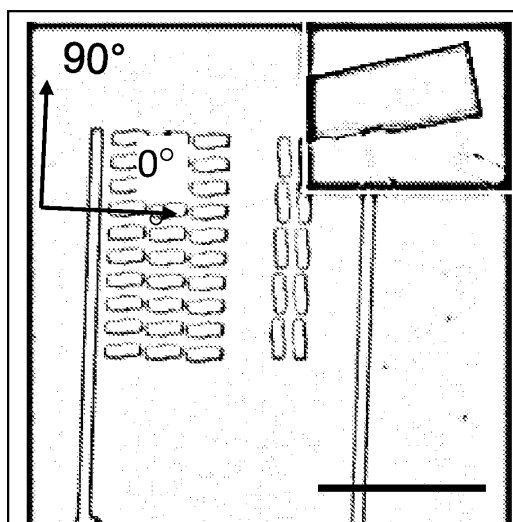


FIG. 18B

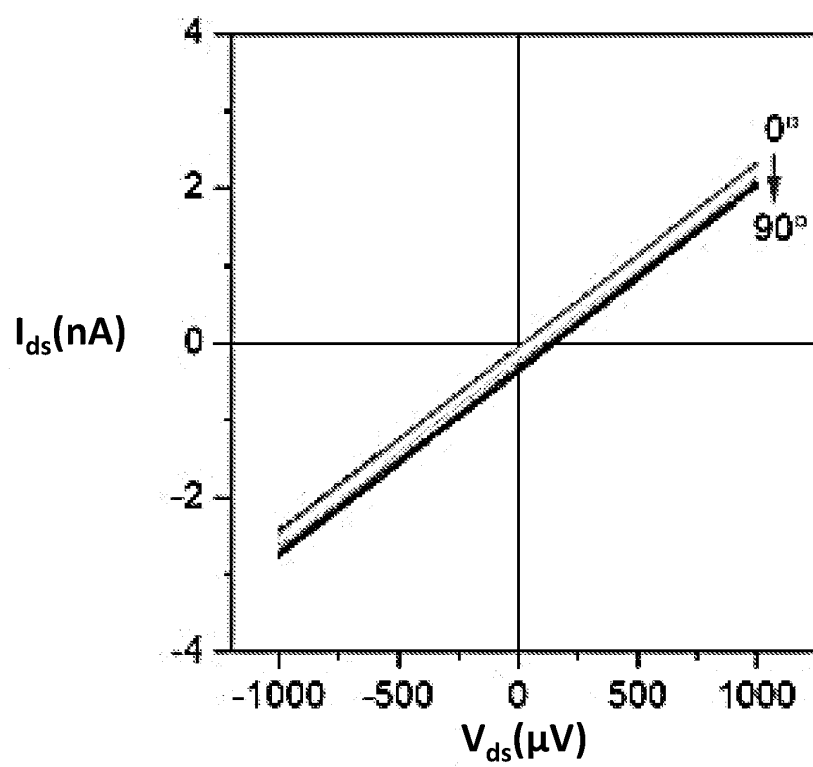


FIG. 18C

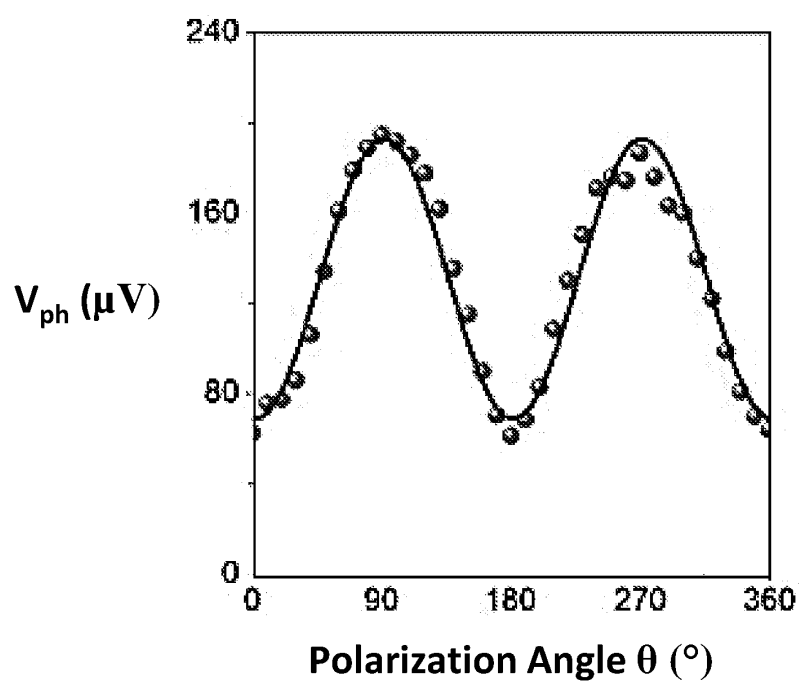


FIG. 19A

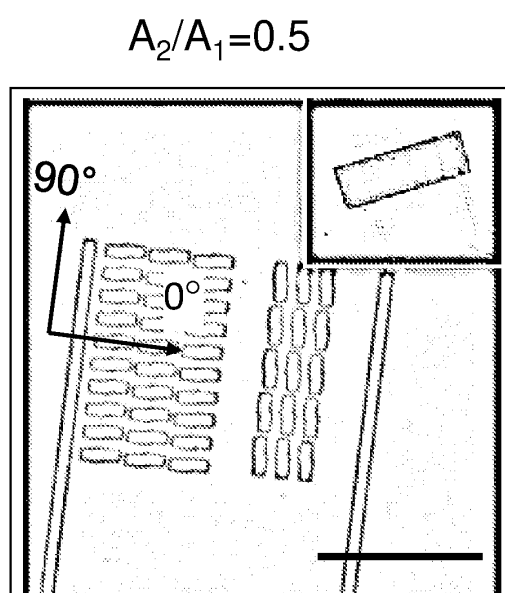


FIG. 19B

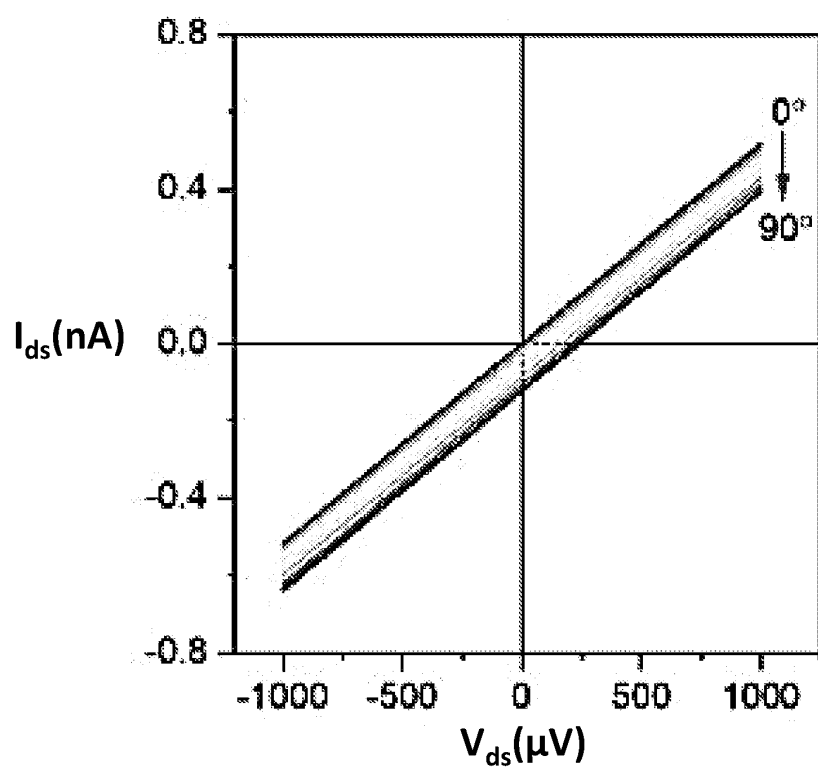


FIG. 19C

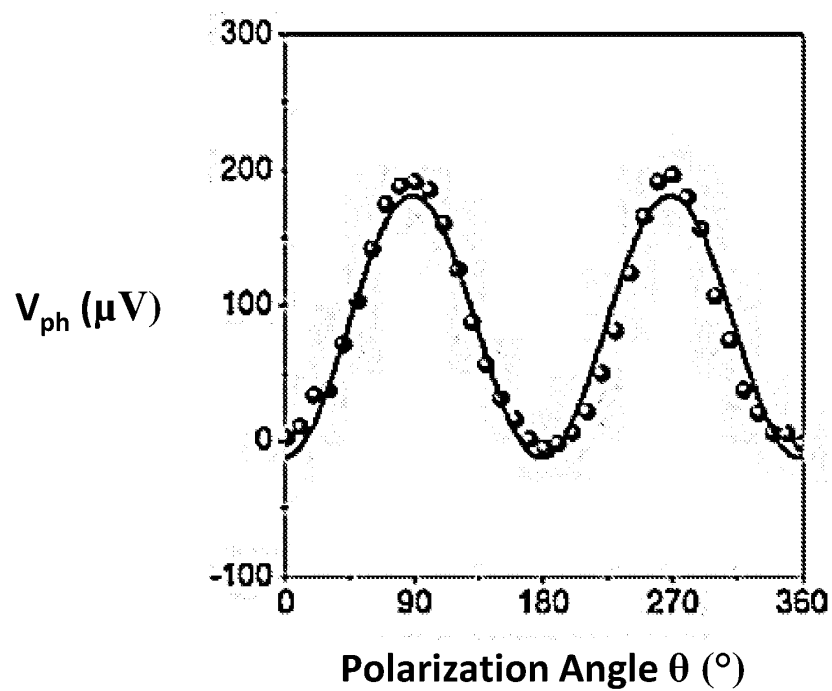


FIG. 20A

$$A_2/A_1=0.67$$

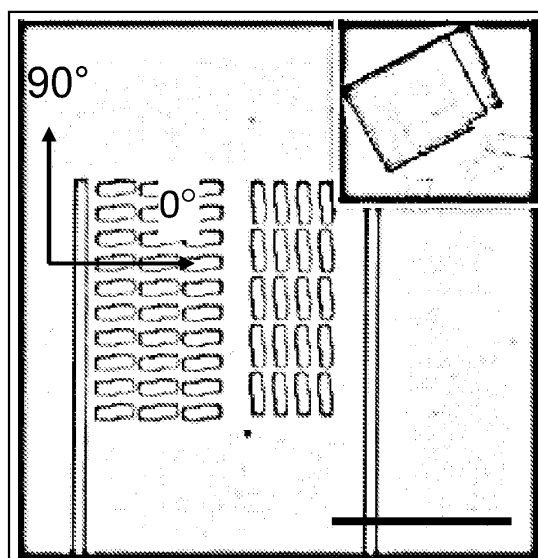


FIG. 20B

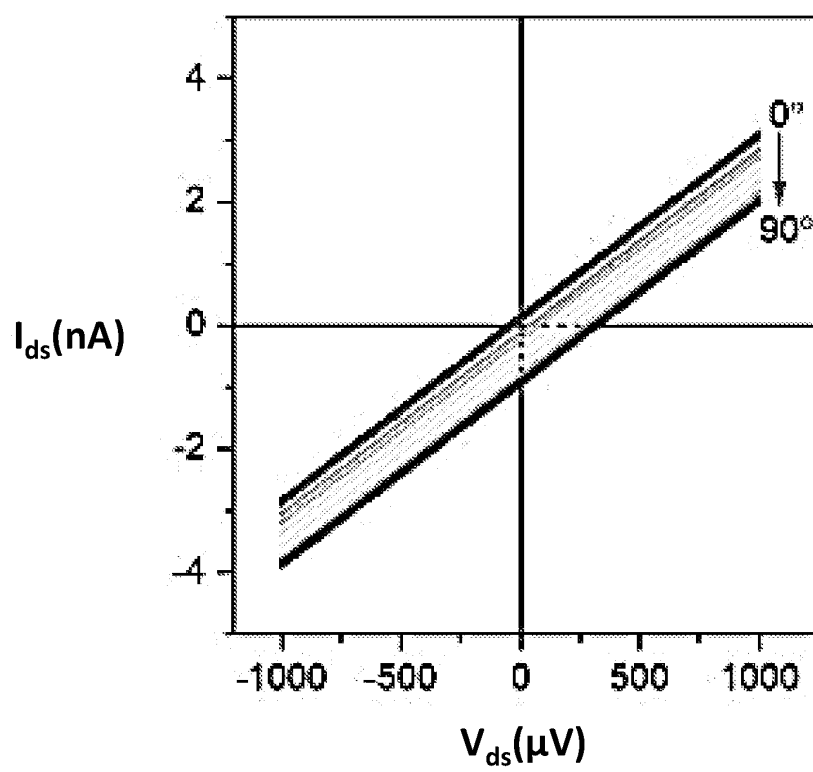


FIG. 20C

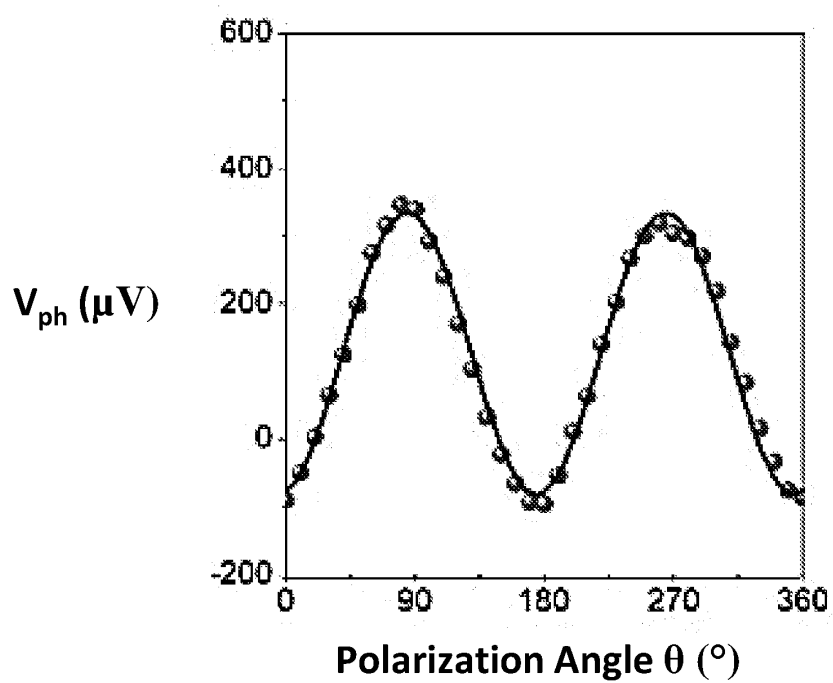


FIG. 21A

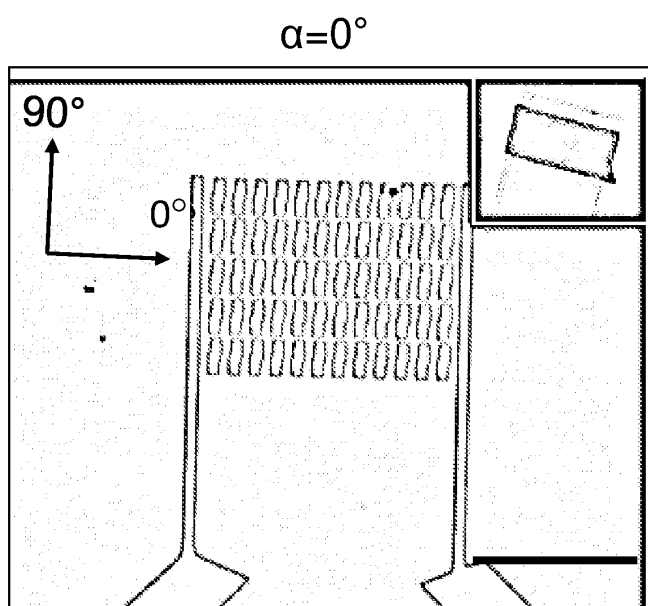


FIG. 21B

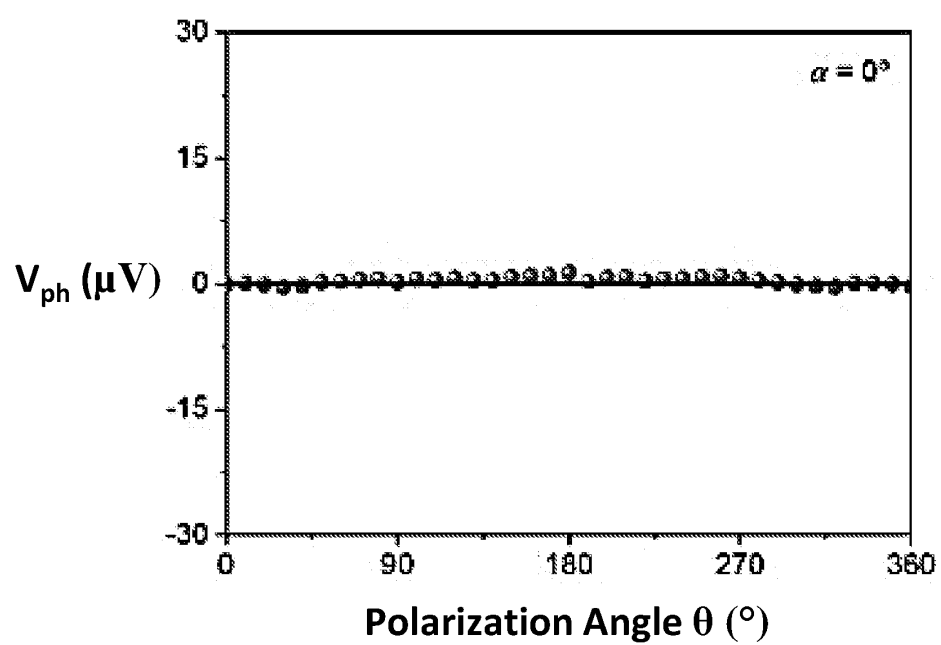


FIG. 22A

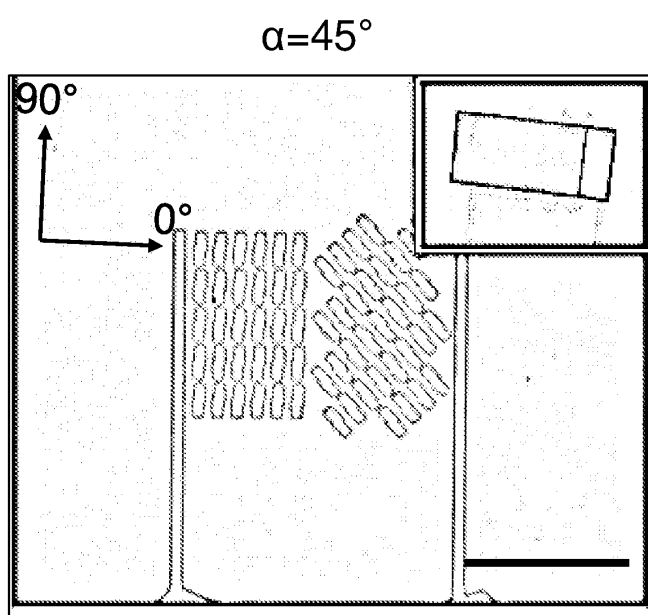


FIG. 22B

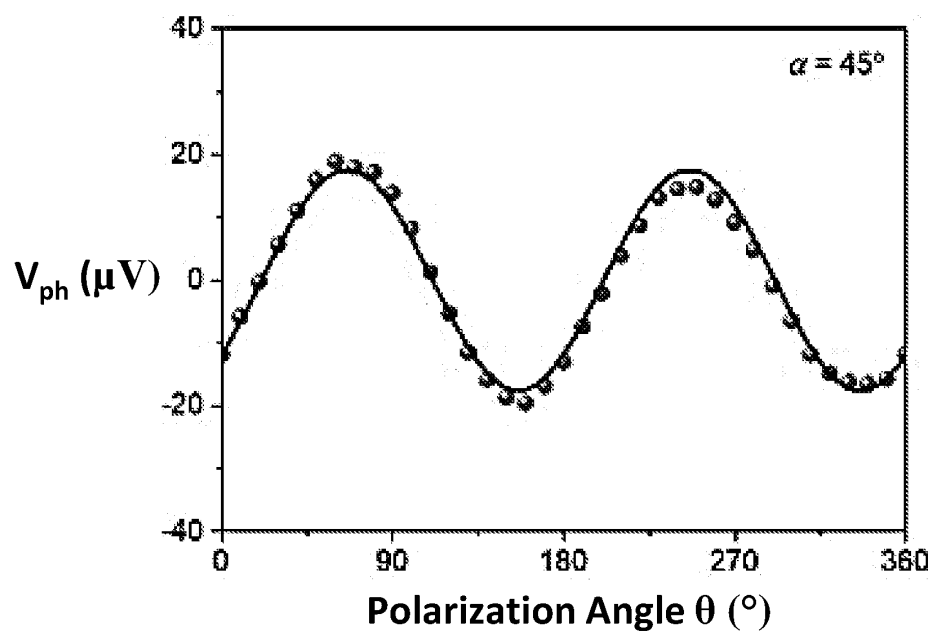


FIG. 23A

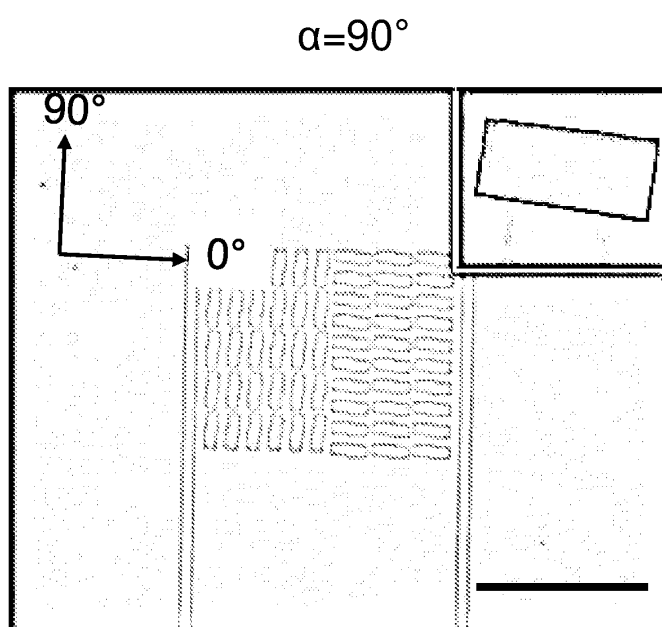


FIG. 23B

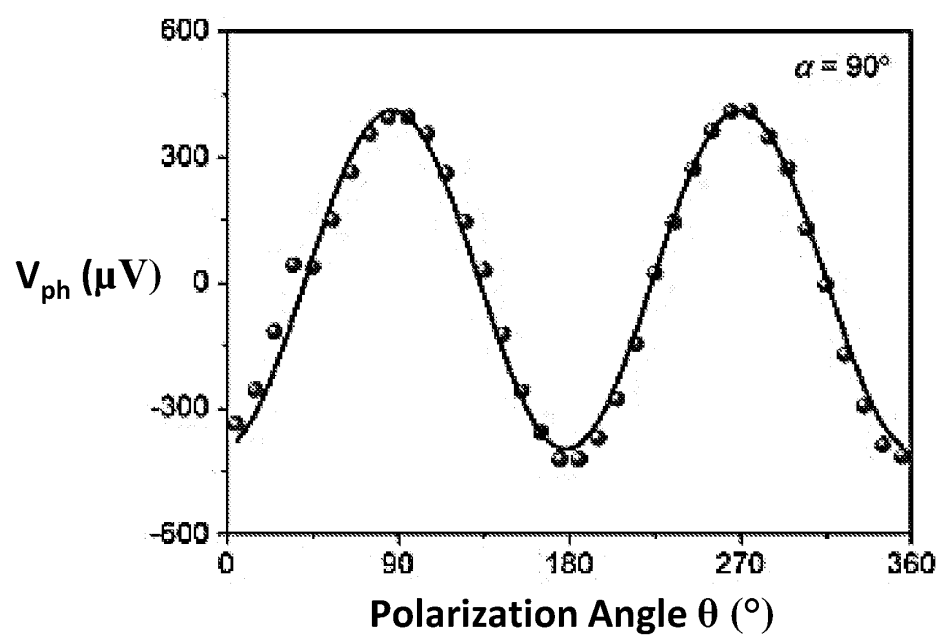
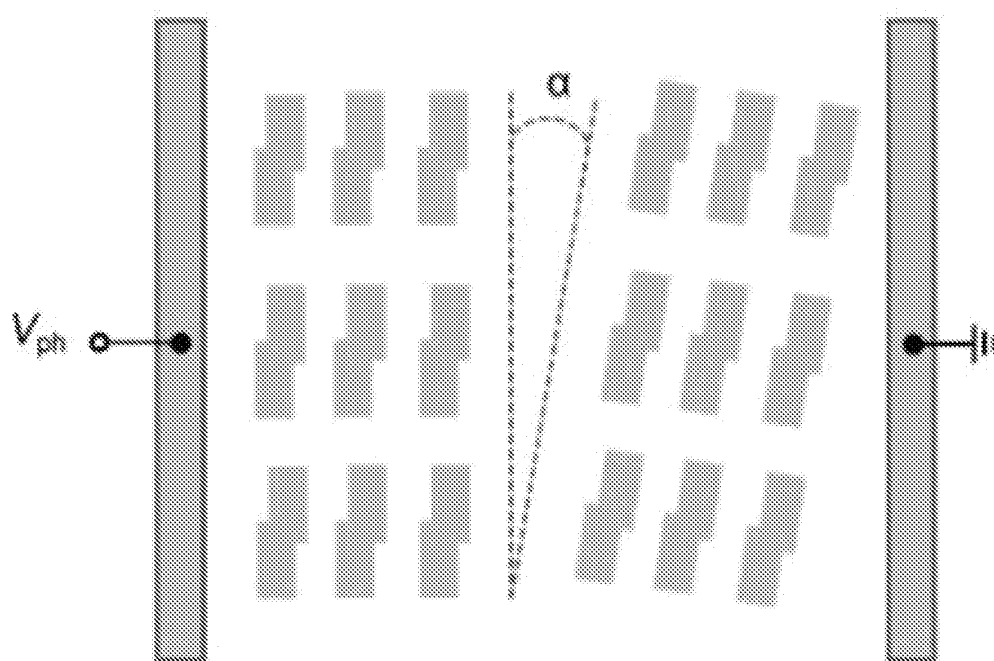


FIG. 24A



$$V_{ph}(\alpha, \theta) = V_{ph}(\theta) + V_{ph}(\alpha, \theta)$$

FIG. 24B

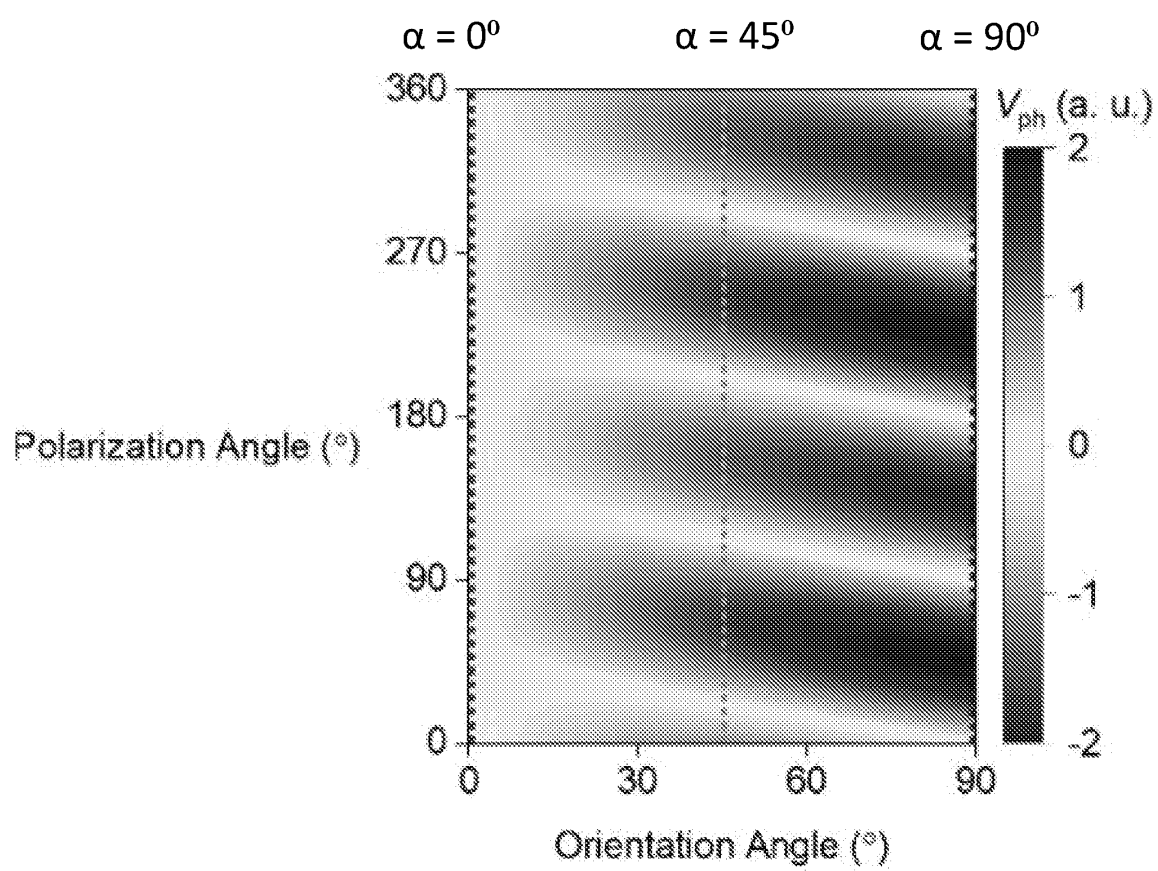


FIG. 24C

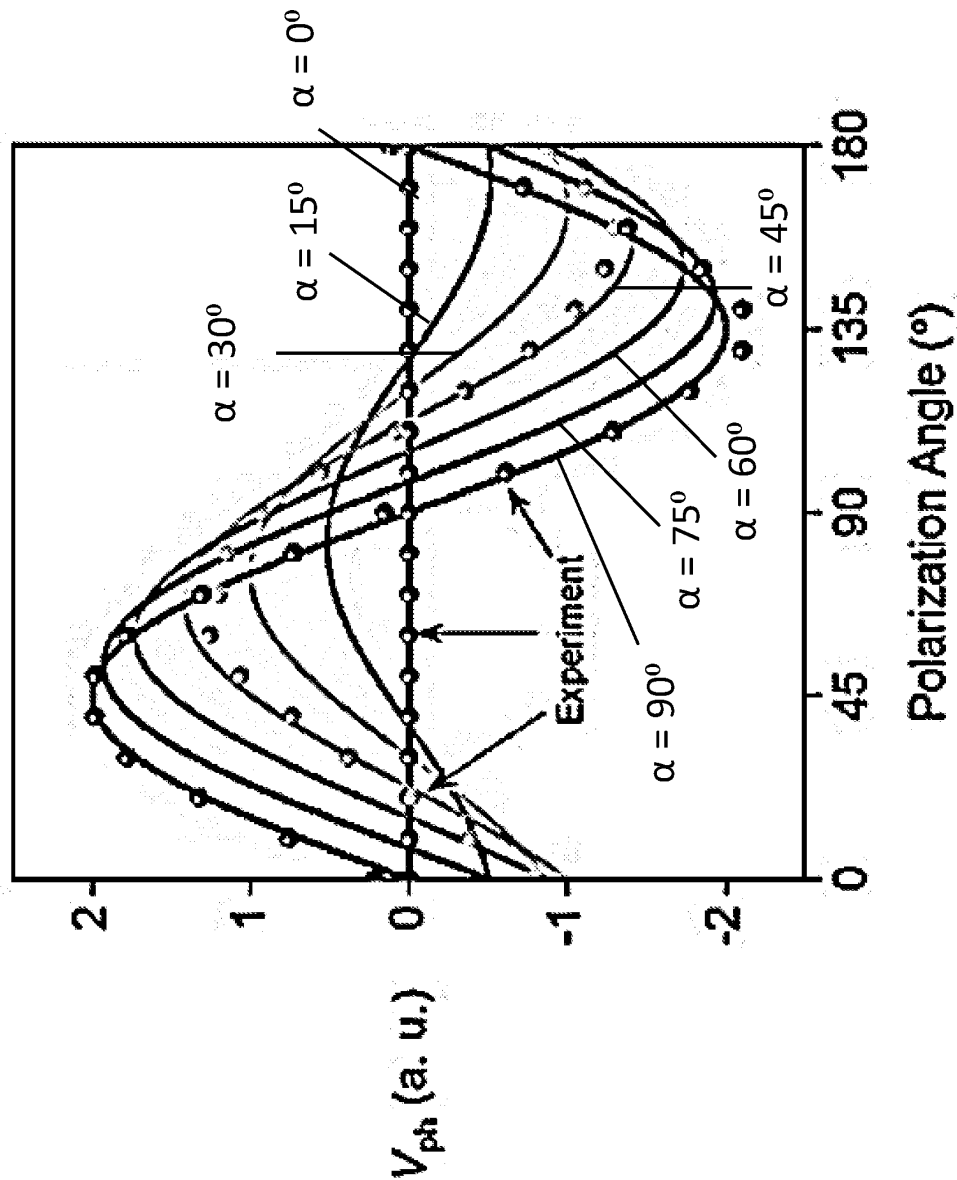
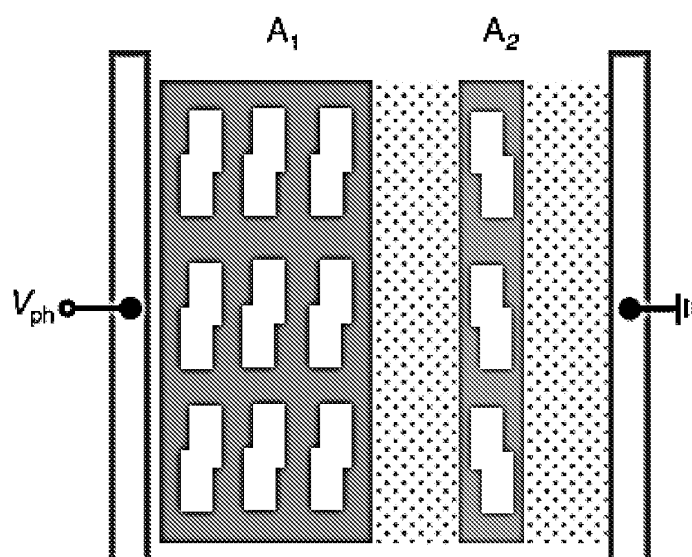


FIG. 25A



$$V_{ph}(A_1, A_2, \Psi) = V_{ph}(A_1, \Psi) + V_{ph}(A_2, \Psi)$$

FIG. 25B

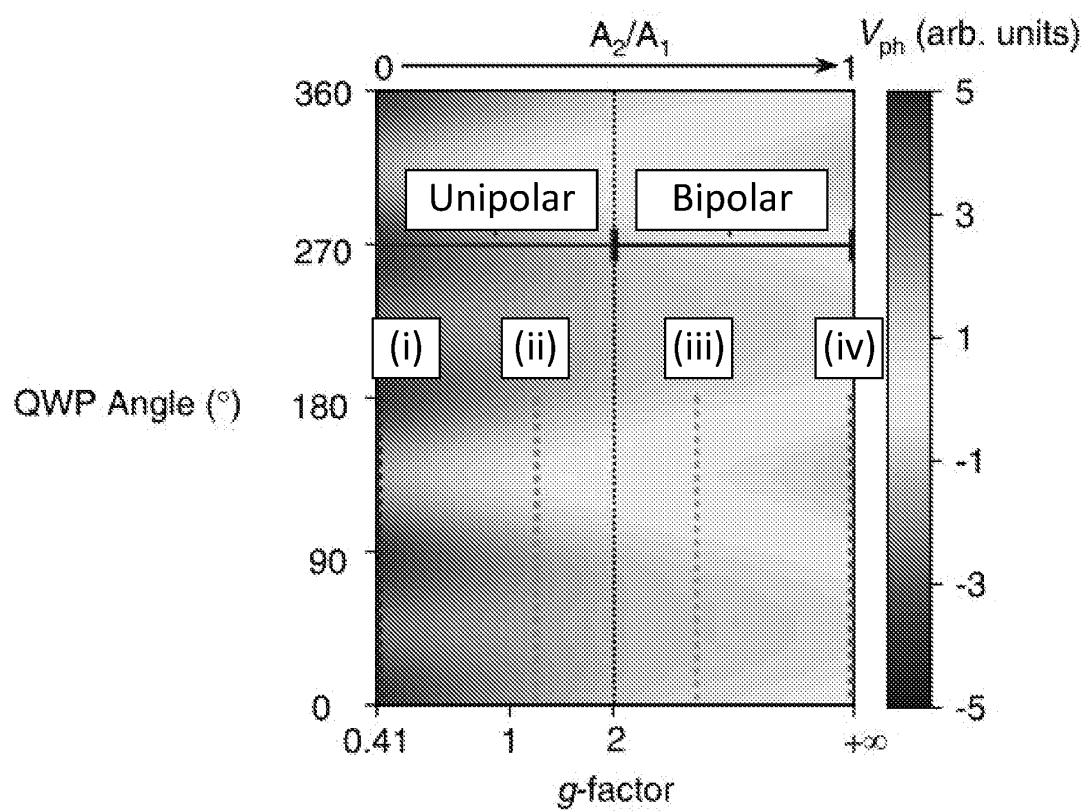


FIG. 25C

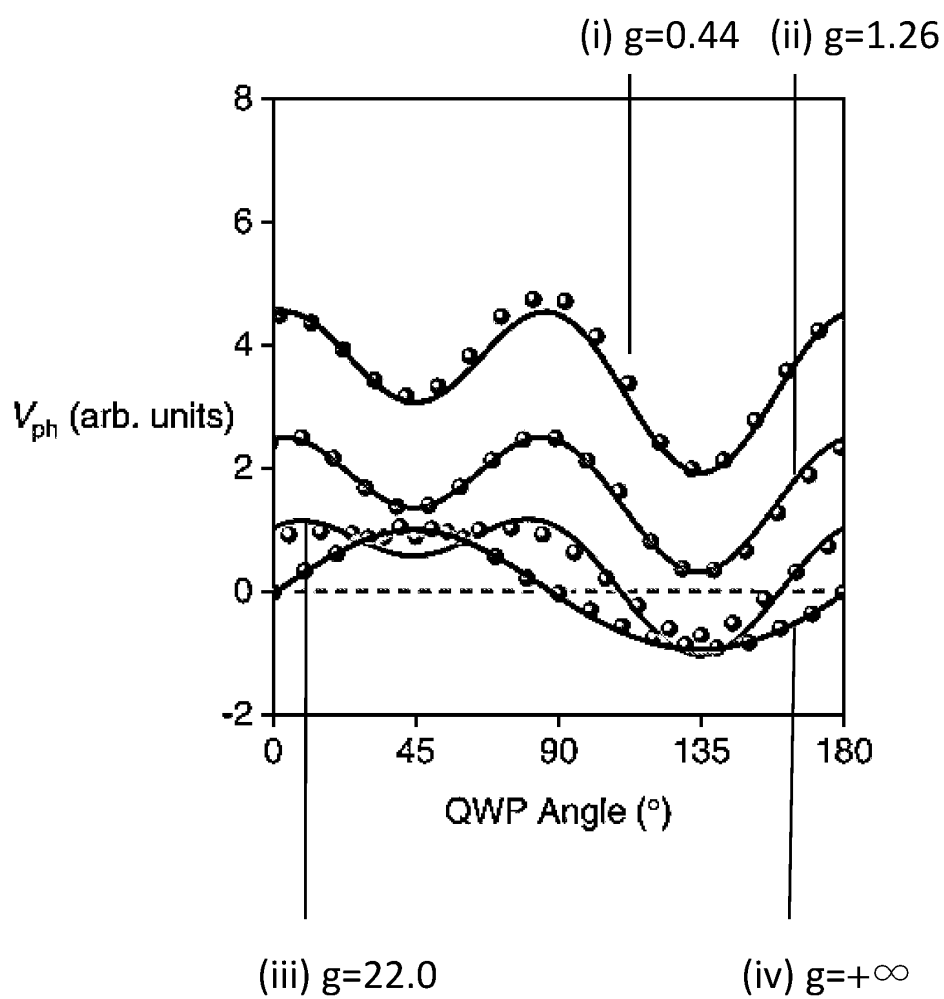


FIG. 26A

$$A_2/A_1=0$$

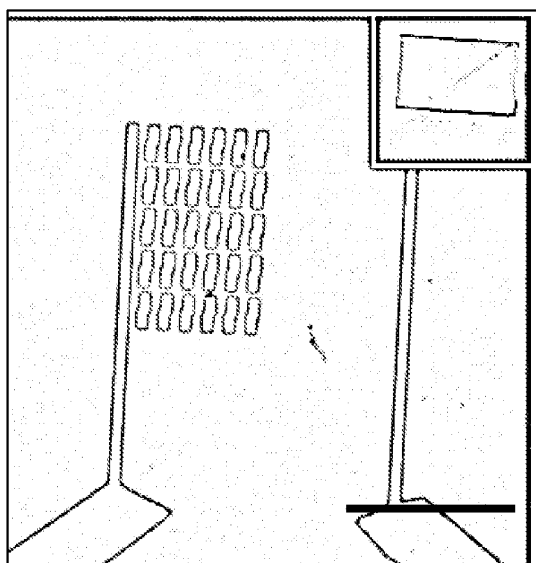


FIG. 26B

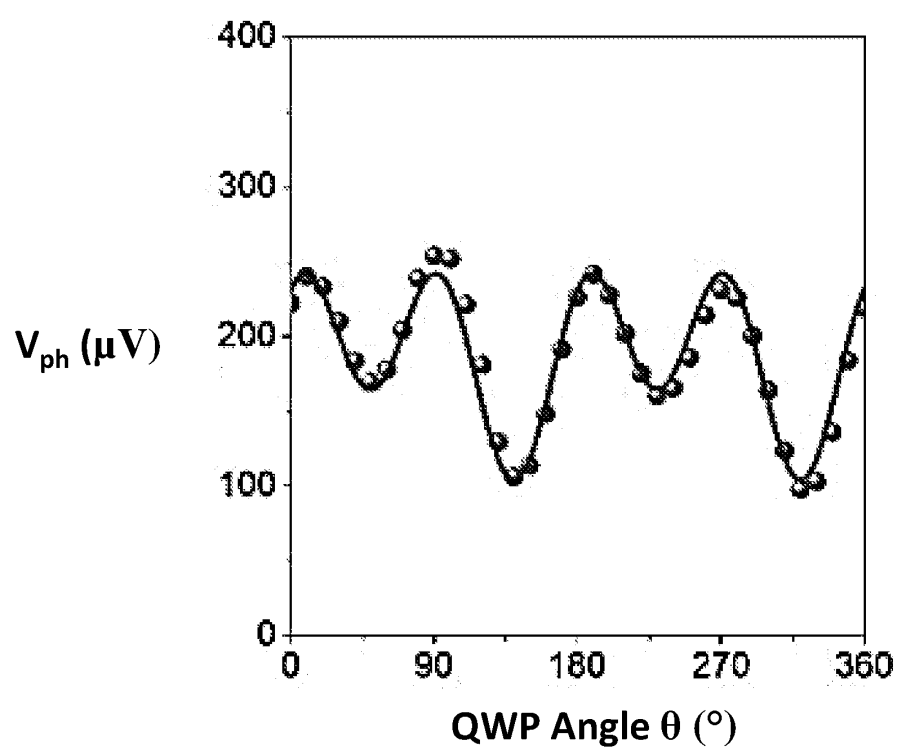


FIG. 27A

$$A_2/A_1=0.33$$

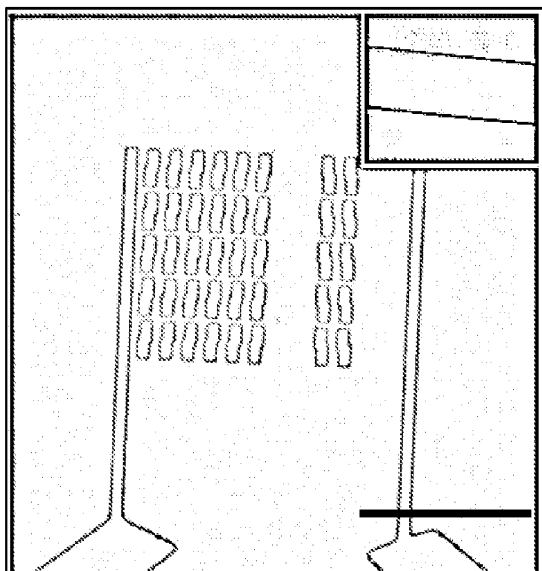


FIG. 27B

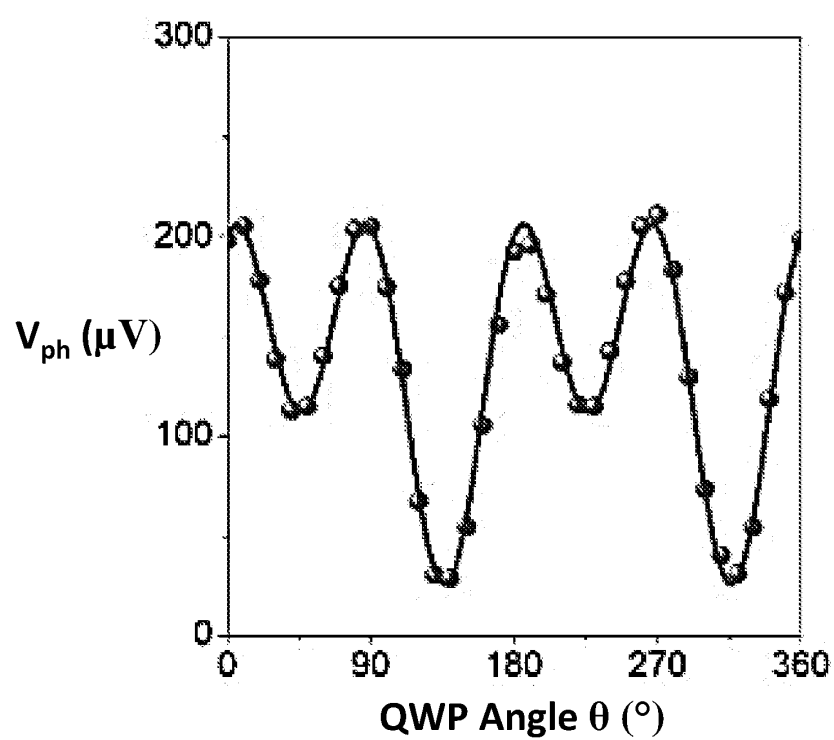


FIG. 28A

$$A_2/A_1=0.67$$

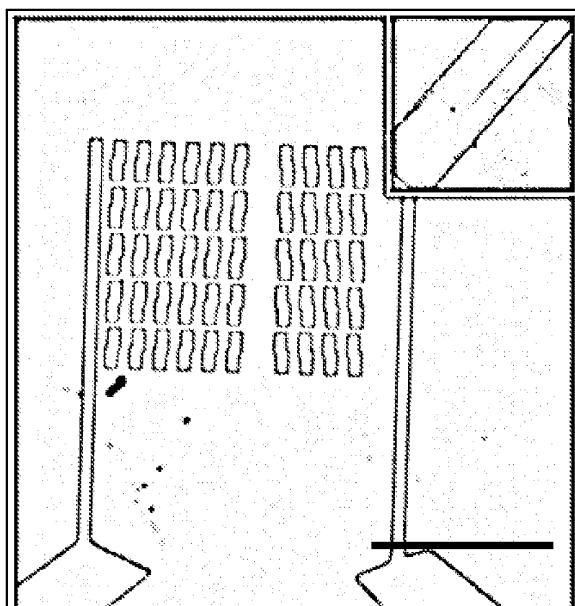


FIG. 28B

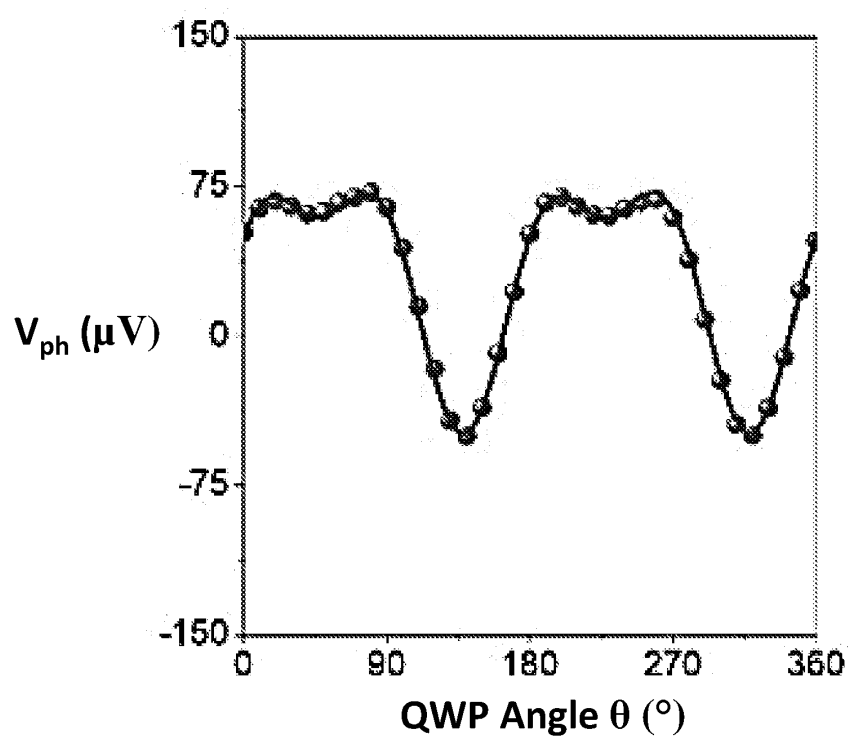


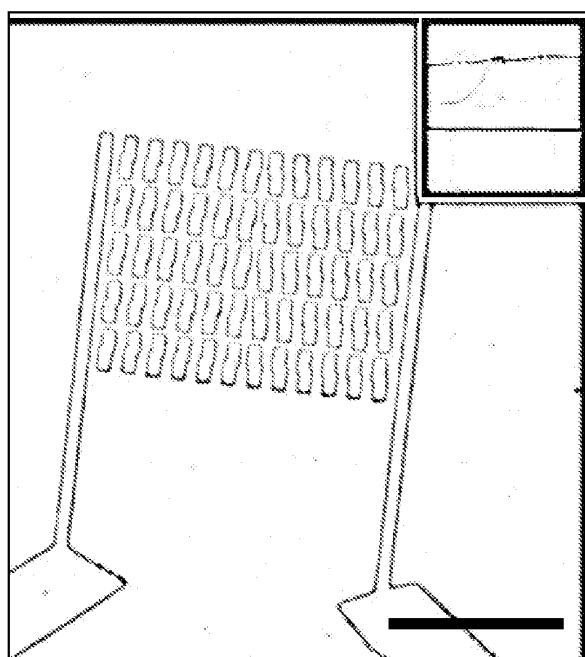
FIG. 29A $\alpha=0^\circ$ 

FIG. 29B

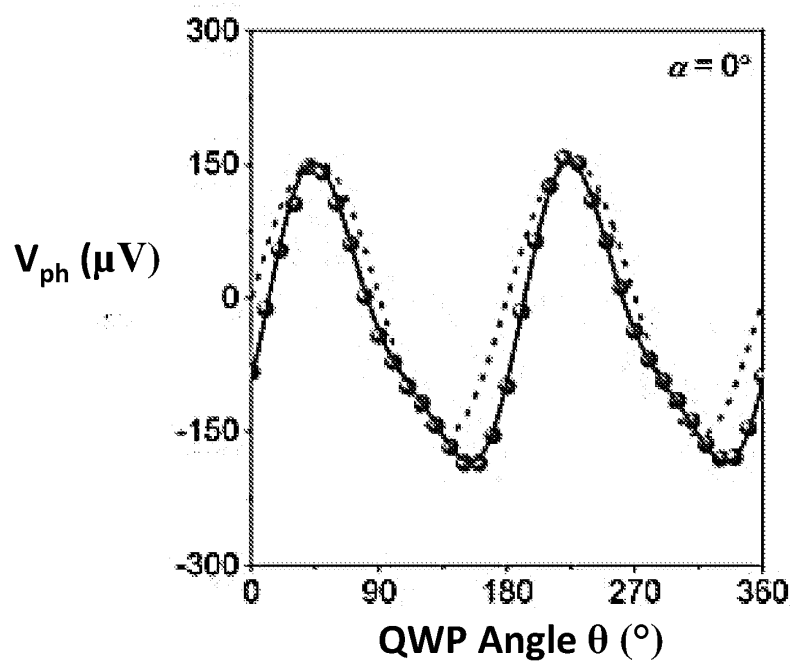


FIG. 30A

$$\alpha = 10^\circ$$

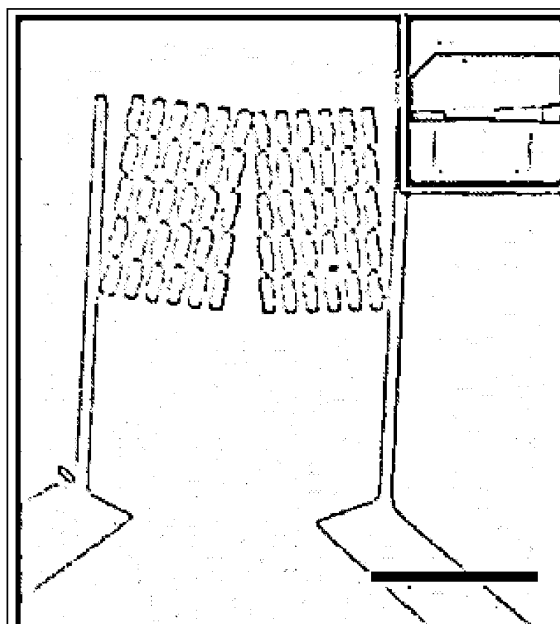


FIG. 30B

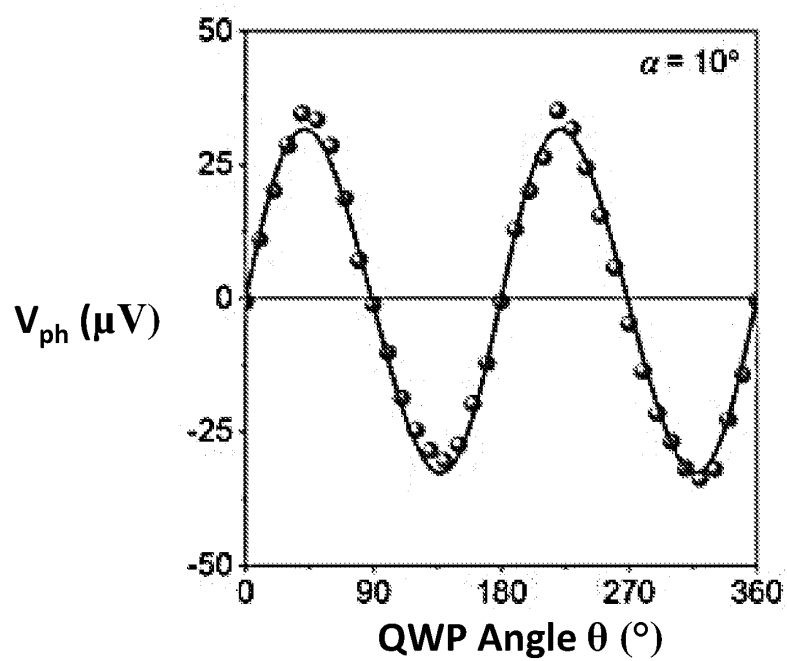


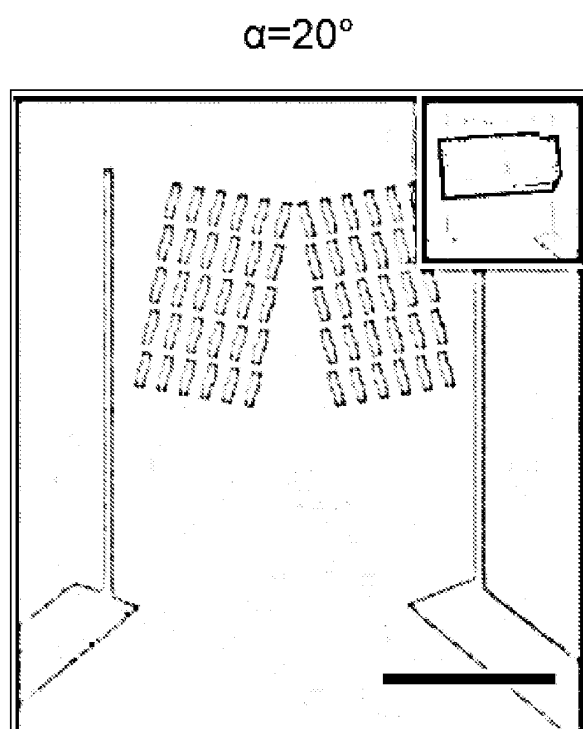
FIG. 31A

FIG. 31B

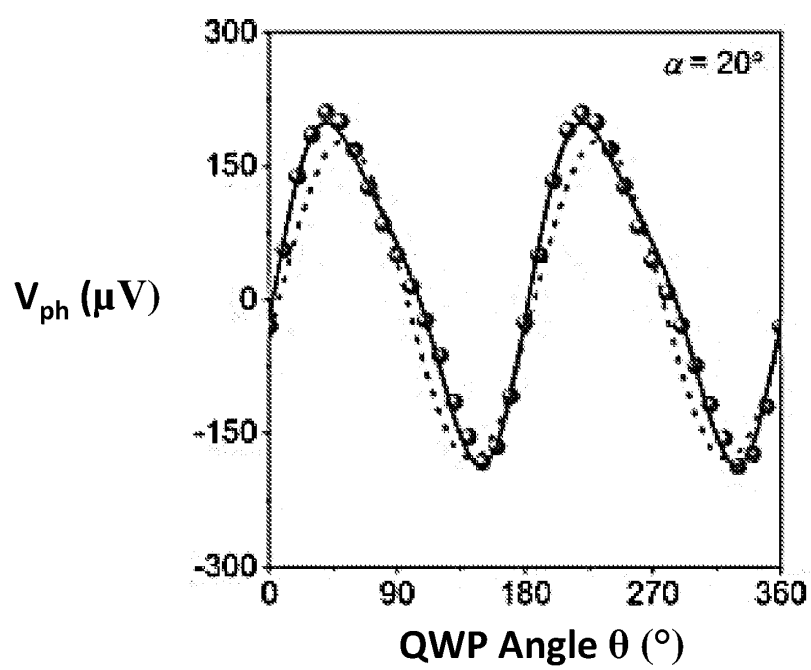


FIG. 32A

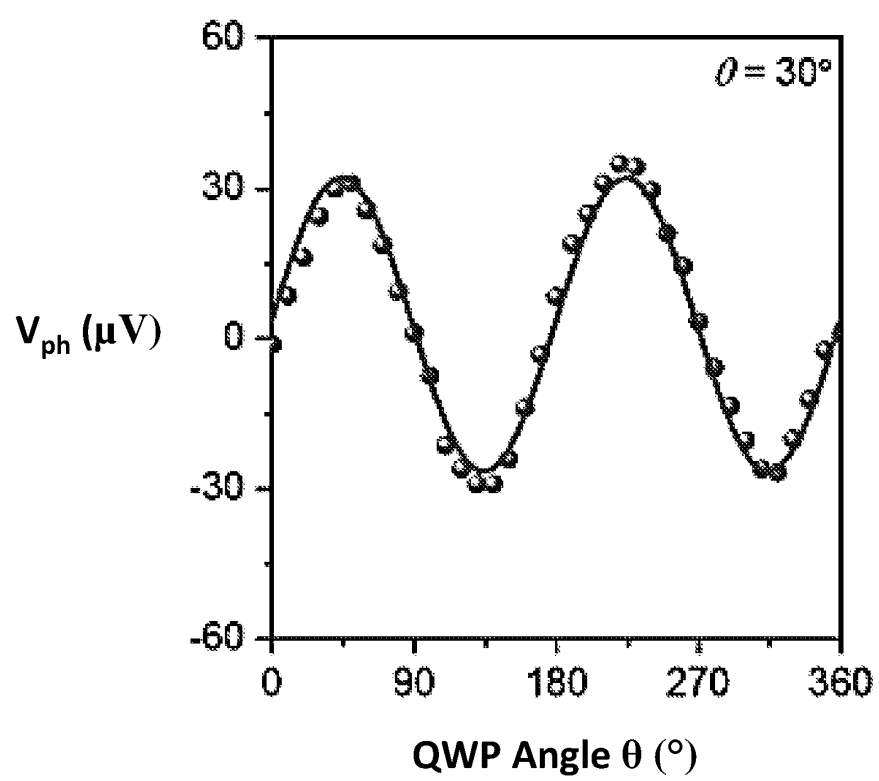


FIG. 32B

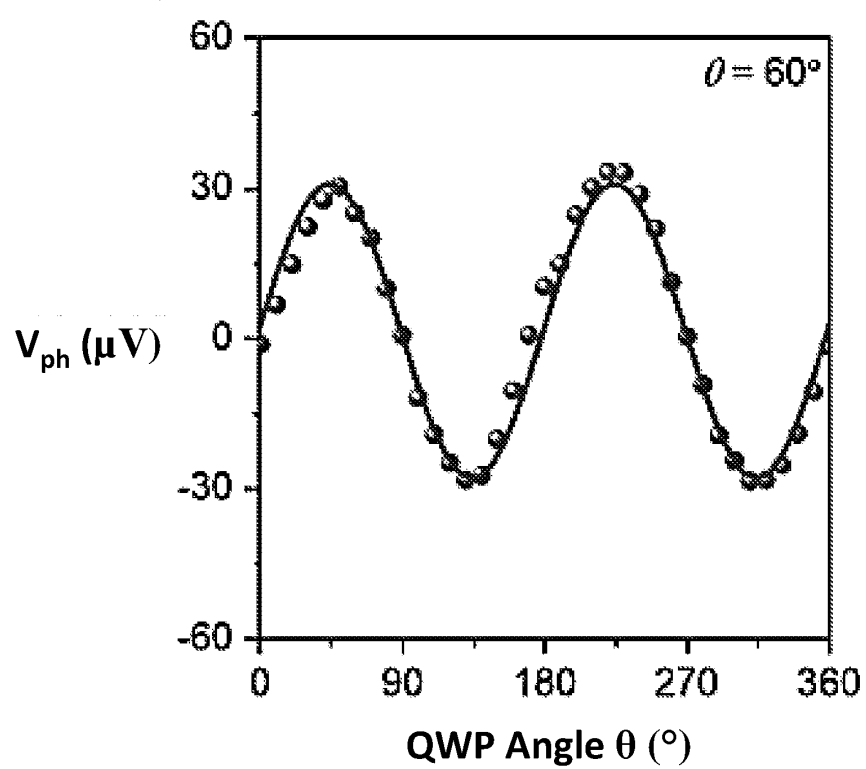


FIG. 32C

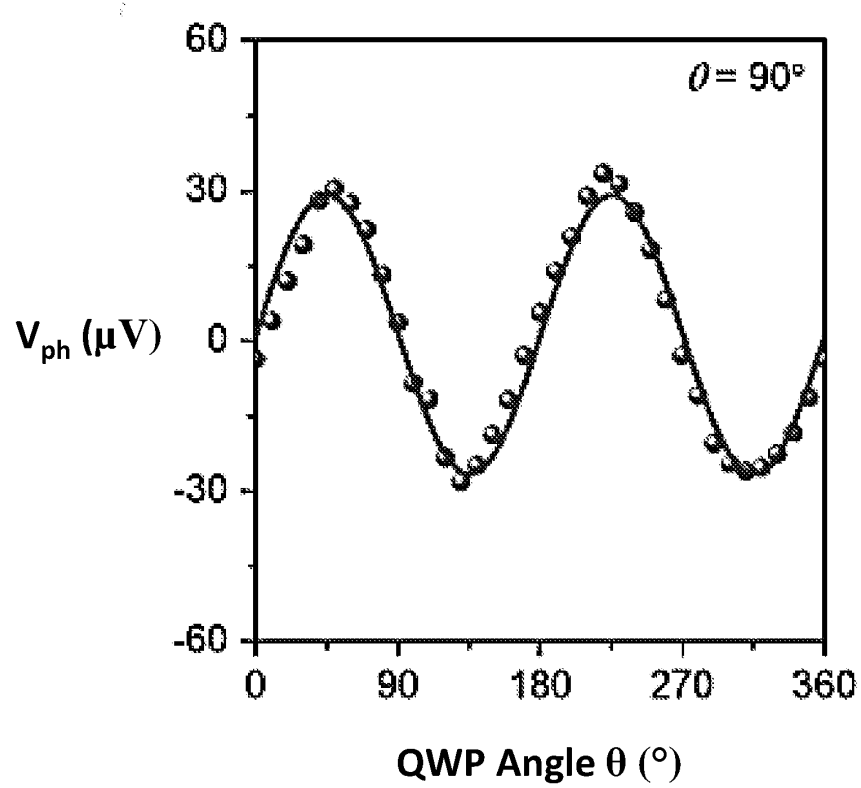


FIG. 32D

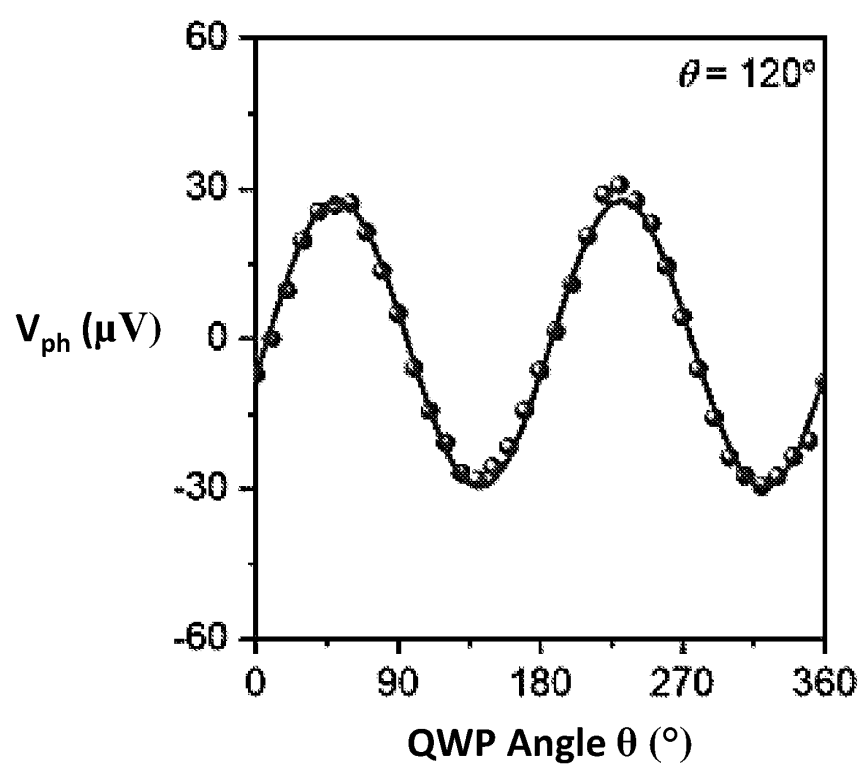


FIG. 32E

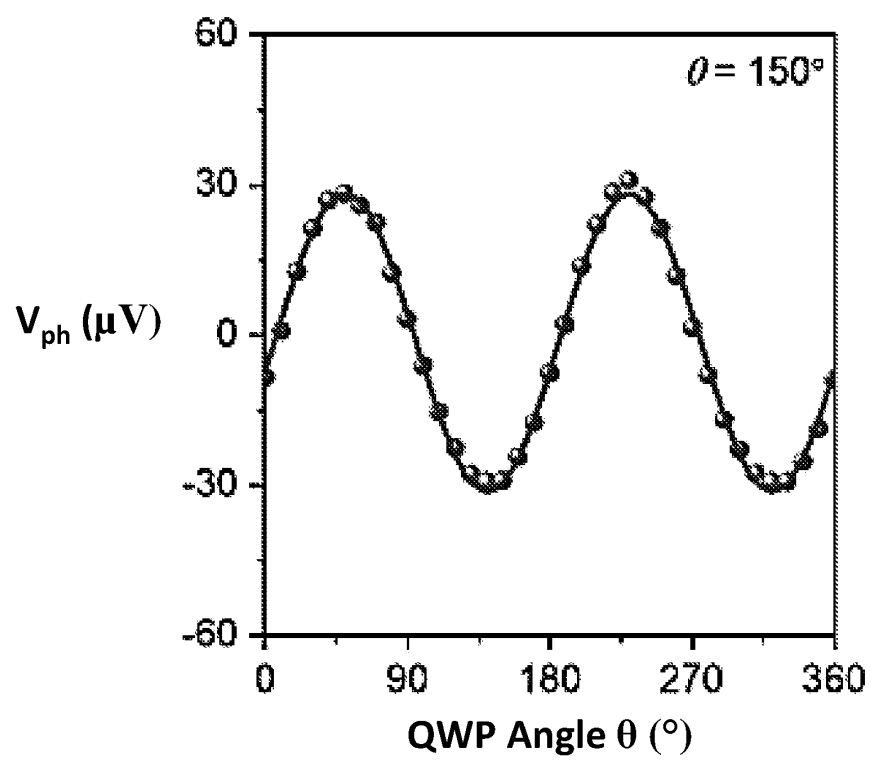


FIG. 32F

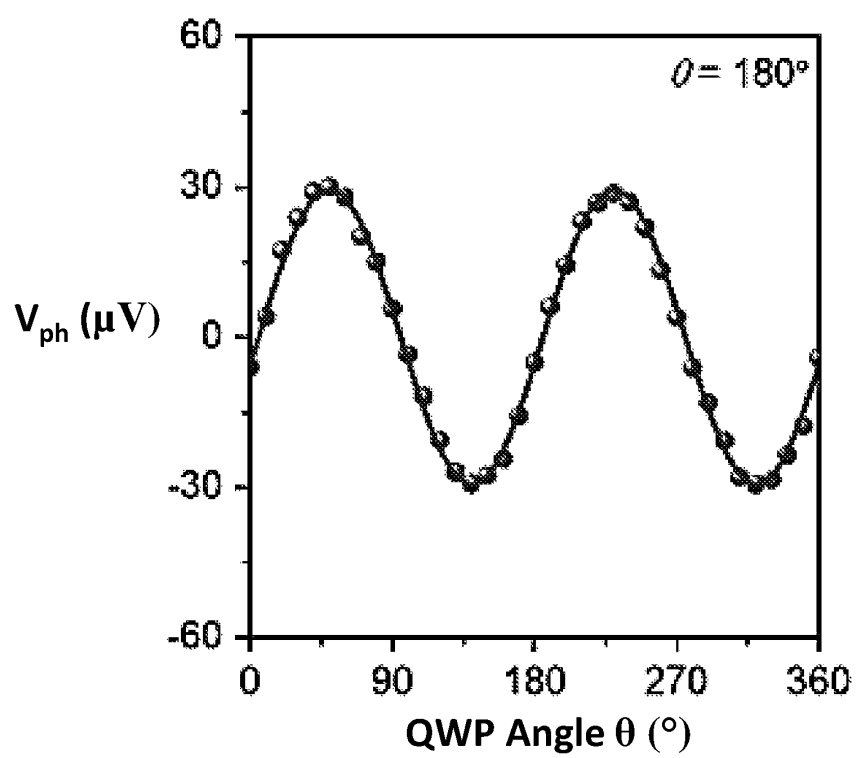


FIG. 33A

Origin of Anisotropy		Materials	Wavelength	Responsivity	Response time	PR
Natural Materials	Intrinsic Crystal Structure	Sb13/Sb2O3	450 nm	1.11 mA/W	200 ms	3.14
		GeSe	532 nm	4.25 A/W	/	1.09
		Gr/PdSe2/Ge	980 nm	691 mA/W	92.5 μ s	91.2
		BP	1200 nm	0.35 mA/W	/	3.5
		BP/WSe2	1550 nm	40 mA/W	0.8 ms	5.88
	External Geometric Structure	BP/MoS2	3500 nm	~ 1 A/W	4 μ s	22
		PdSe2	4600 nm	21.6 V/W	51.9 μ s	2.06
		CdSe2 nanowires	400 nm	0.3 A/W	/	1.13
		CH3NH3PbI3 nanowires	500 nm	45 A/W	131 ns	-2.39
		1D CsPbBr3 arrays	513 nm	1000 A/W	23.4 μ s	2.6
Artificial Materials		Gr/grating antenna	400-800 nm	5 V/W	/	3
		BP/bowtie antenna	1550 nm	14.2 mA/W	90 μ s	8.7
		Gr/bowtie antenna	6-7 μ m	15 mA/W	17 ns	~1.5
		Gr/nano-stripes	3-20 μ m	0.6 A/W	7 ps	~6
		Gr/T-shaped antenna	4 μ m	36.3 mA/W	<100 μ s	-1
		Gr/tapered antenna	3.6-4.1 μ m	15.6 V/W	667 ns	1 $\rightarrow$ + ∞ - ∞ $\rightarrow$ -1
		PdSe2/Z-shaped antenna	5.3 μ m	3.6 V/W	76 μ s	1 $\rightarrow$ + ∞ - ∞ $\rightarrow$ -1

Prior works

Embodiment

FIG. 33B

Origin of Chirality		Materials	Wavelength	Responsivity	Response time	g-factor
Natural Materials	Chiral Absorption	1-aza[6]helicene	365 nm	0.1 μ A/W	2.6 ms	1.93
		(α -PEA) ₂ PbI ₂	395 nm	797 mA/W	~6.7 ms	0.1
		(NEA) PbI ₃	395 nm	280 mA/W	/	1.85
		(NEA) ₂ (MA) _{n-1} Pb _n Br _{n+1}	405 nm	15.7 A/W	/	0.15
		[(R)-bMPA] ₂ AgBiI ₄	400-550 nm	22 μ A/W	0.96 s	0.23
		(β -MPA) ₂ MAPb ₂ Br ₇	500-600 nm	1.1 A/W	2.1 ms	0.11
		(α -PEA) ₂ PbI ₄	532 nm	47.1 A/W	347 μ s	0.13
		ProSQ-C ₆ -PCBM	550 nm	64.5 mA/W	/	0.1
		bis[60]PCBM	300-700 nm	/	43 ms	1.27
		PODTPPD-BT	750-1000 nm	300 A/W	0.31 s	1.9
	Spin PGE	Bi ₂ Te ₂ Se	633 nm	1.66 mA/W	/	1.55
		Bi _{1.5} Sb _{0.5} Te _{1.3} Se _{1.2}	532 nm	/	/	1.74
	Inverse Spin Hall Effect	Au/InP	532 nm	/	/	∞
		Pt/GaAs	670 nm	/	/	∞
	Spin-Dependent Recombination	GaAs _{1-x} N _x	640-840 nm	/	/	0.075
		GaAs _{1-x} N _x	852 nm	/	/	0.05
Artificial Materials		X-shaped Al	500-600 nm	92.5 mA/W	/	0.8
		Chiral Ag Cavity	660 nm	/	6.2 ms	1.6
		Ag/Au/MoSe ₂	500-900 nm	2.46 mA/W	< 100 ms	0.38
		Z-shaped Ag	1.2-1.7 μ m	2.2 mA/W	/	1.1
		Chiral Au/Si	14.-1.7 μ m	27 mA/W	/	1.27
		Chiral Au/Gr	3.6-4.0 μ m	0.8 μ A/W	/	1.5
		Chiral Au/PdSe ₂	5.3 μ m	95 mV/W	76 μ s	0.44 $\rightarrow\infty$

Prior works

Embodiment

FIG. 34A

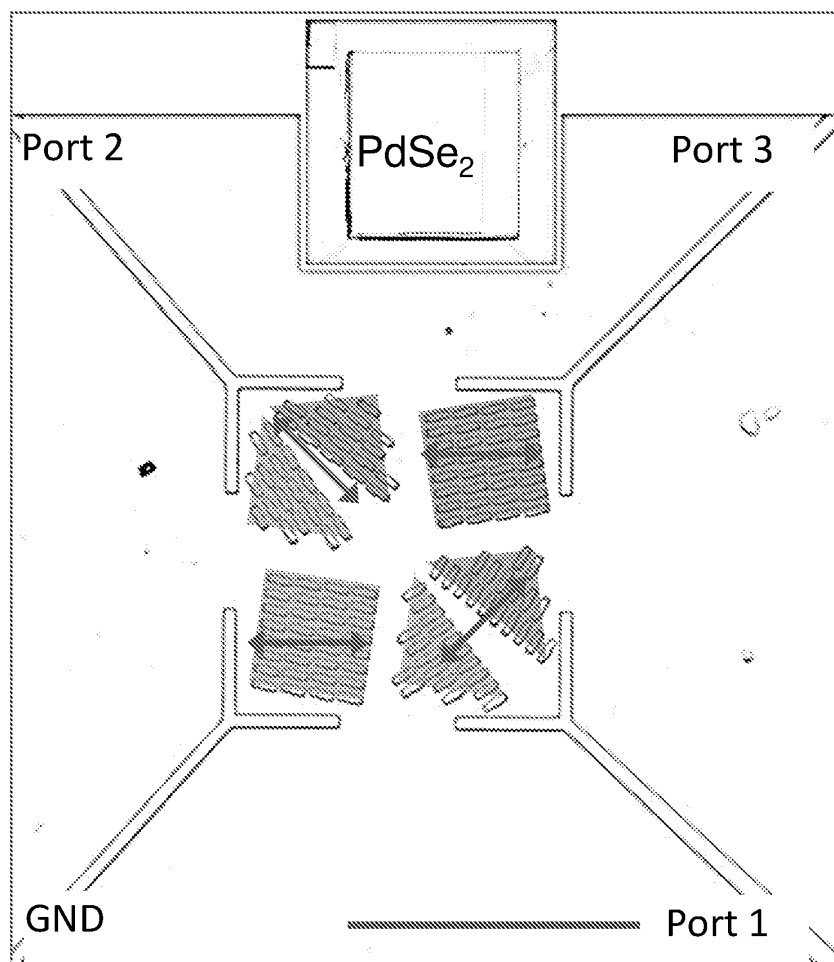


FIG. 34B

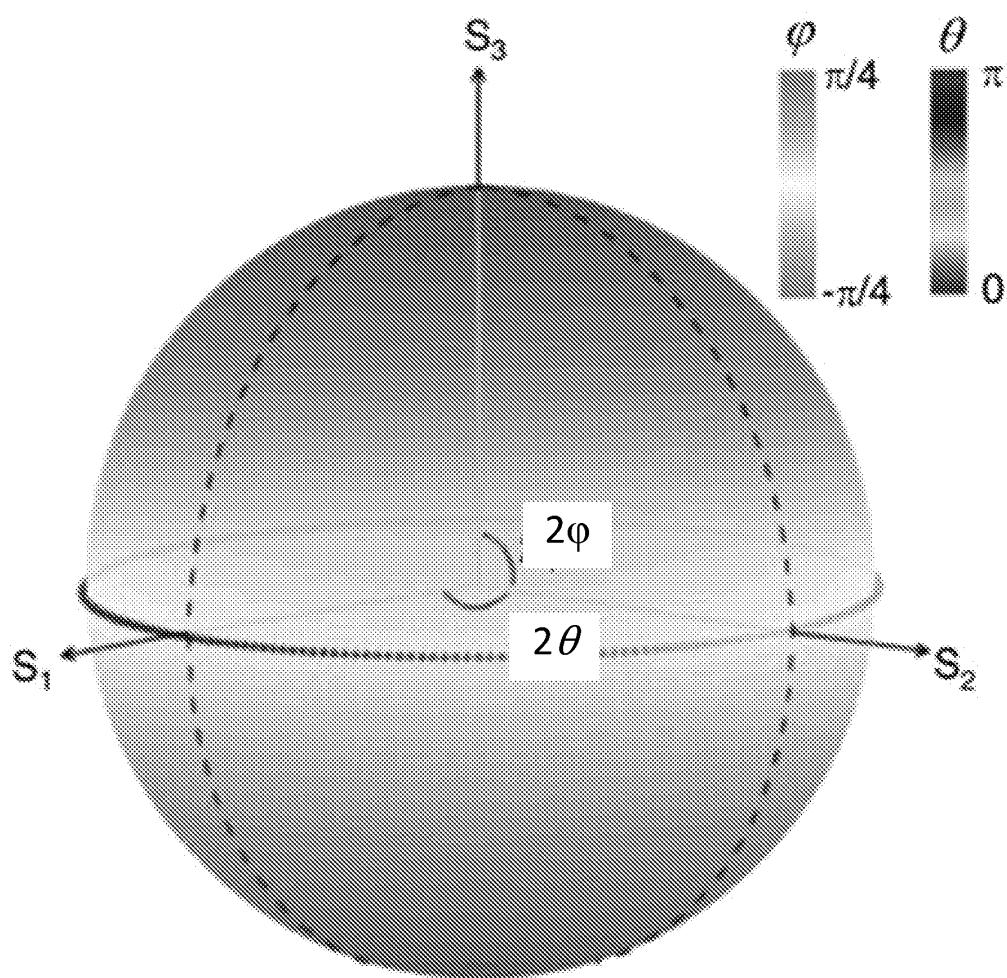


FIG. 35A

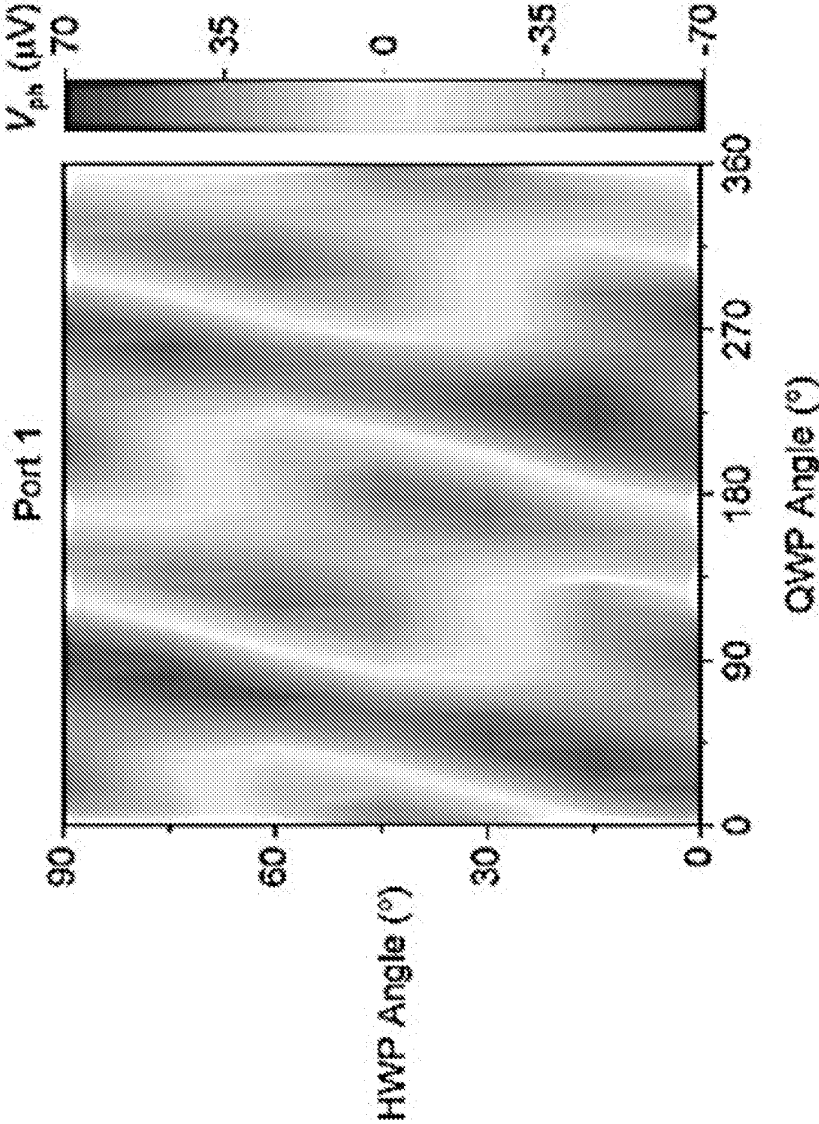


FIG. 35B

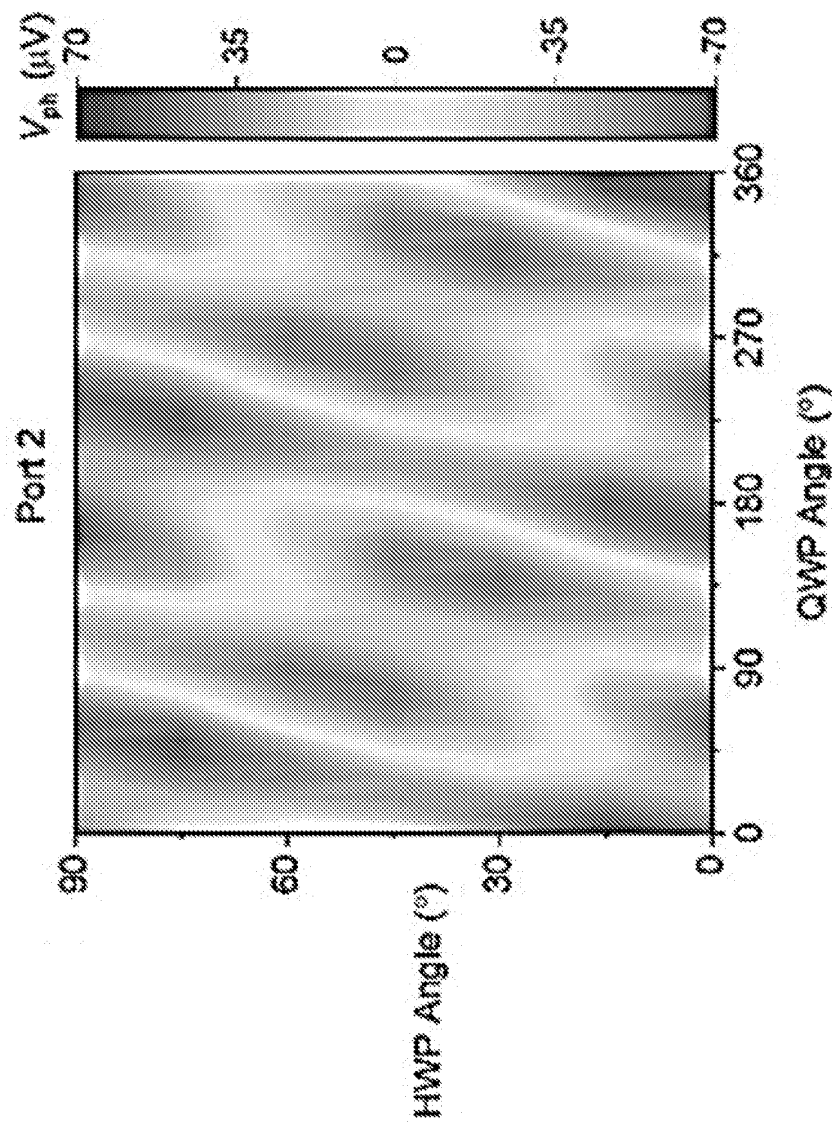


FIG. 35C

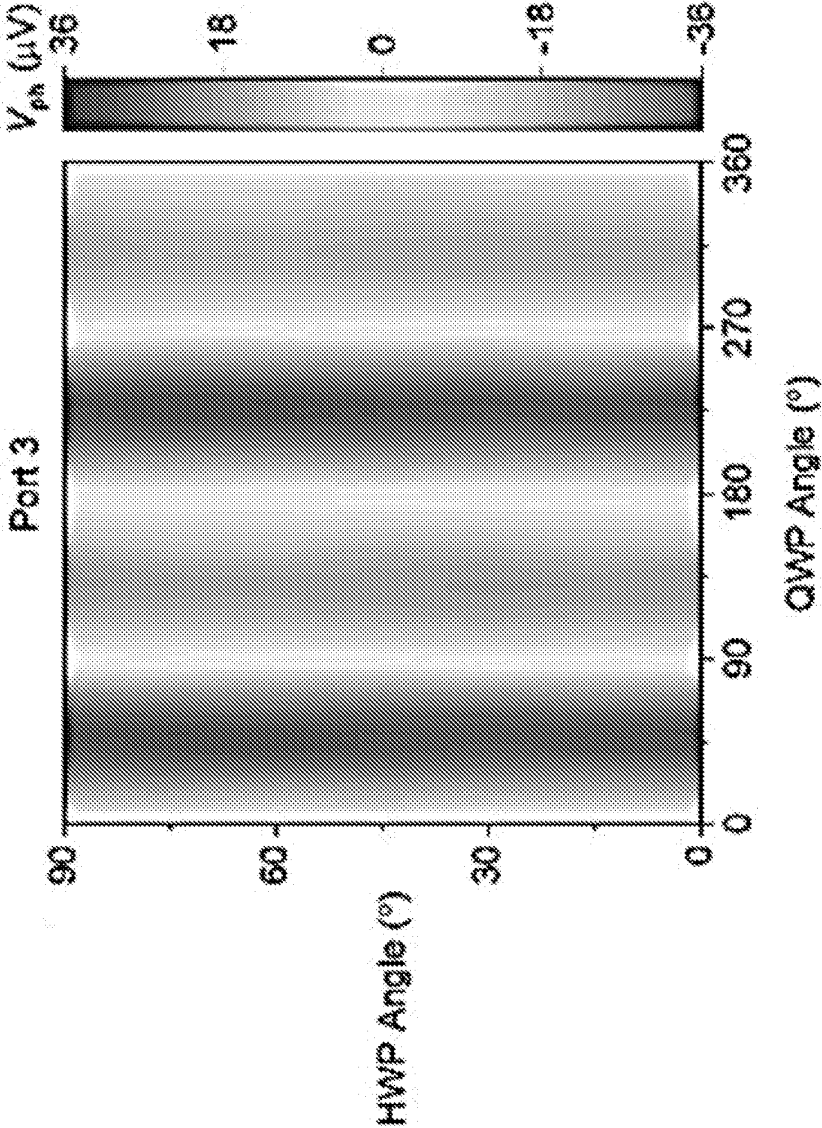


FIG. 36A

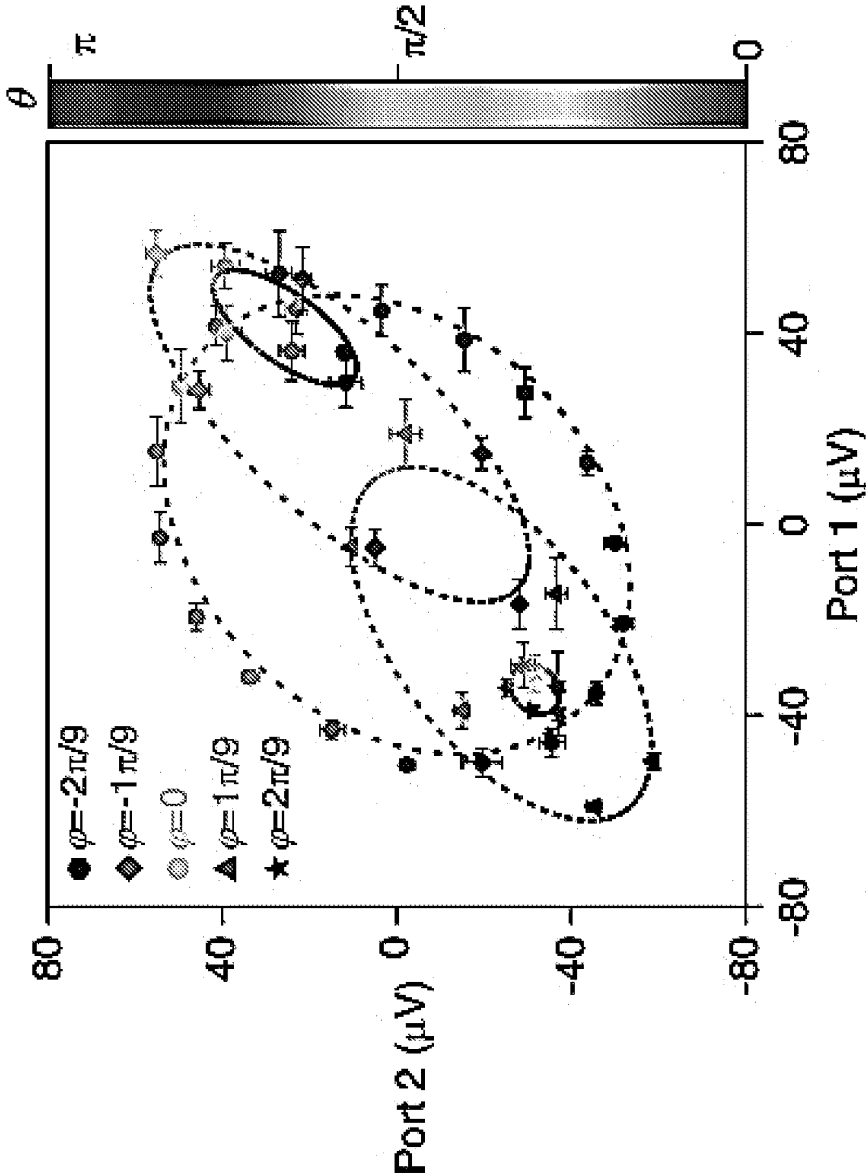


FIG. 36B

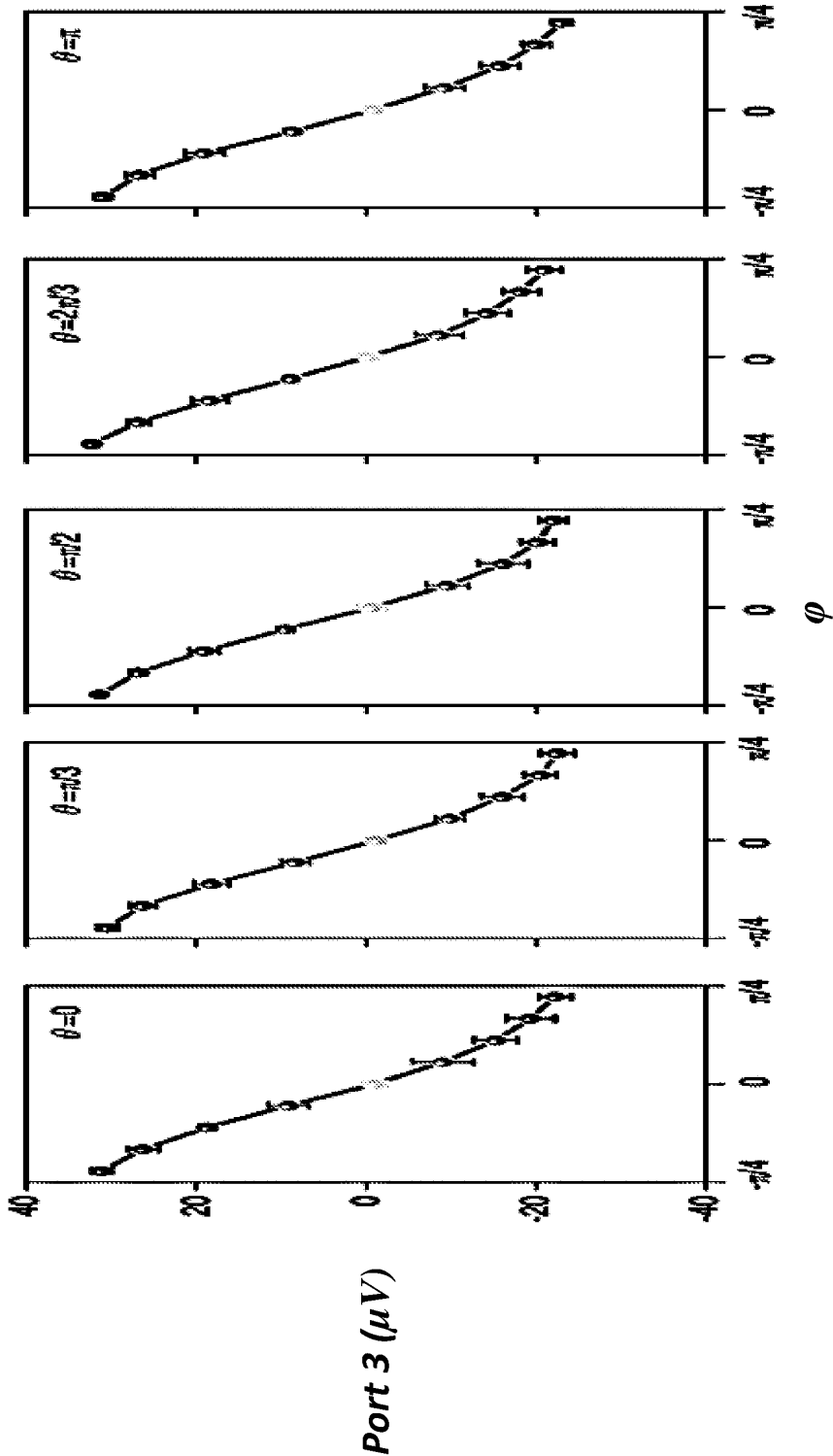


FIG. 36C

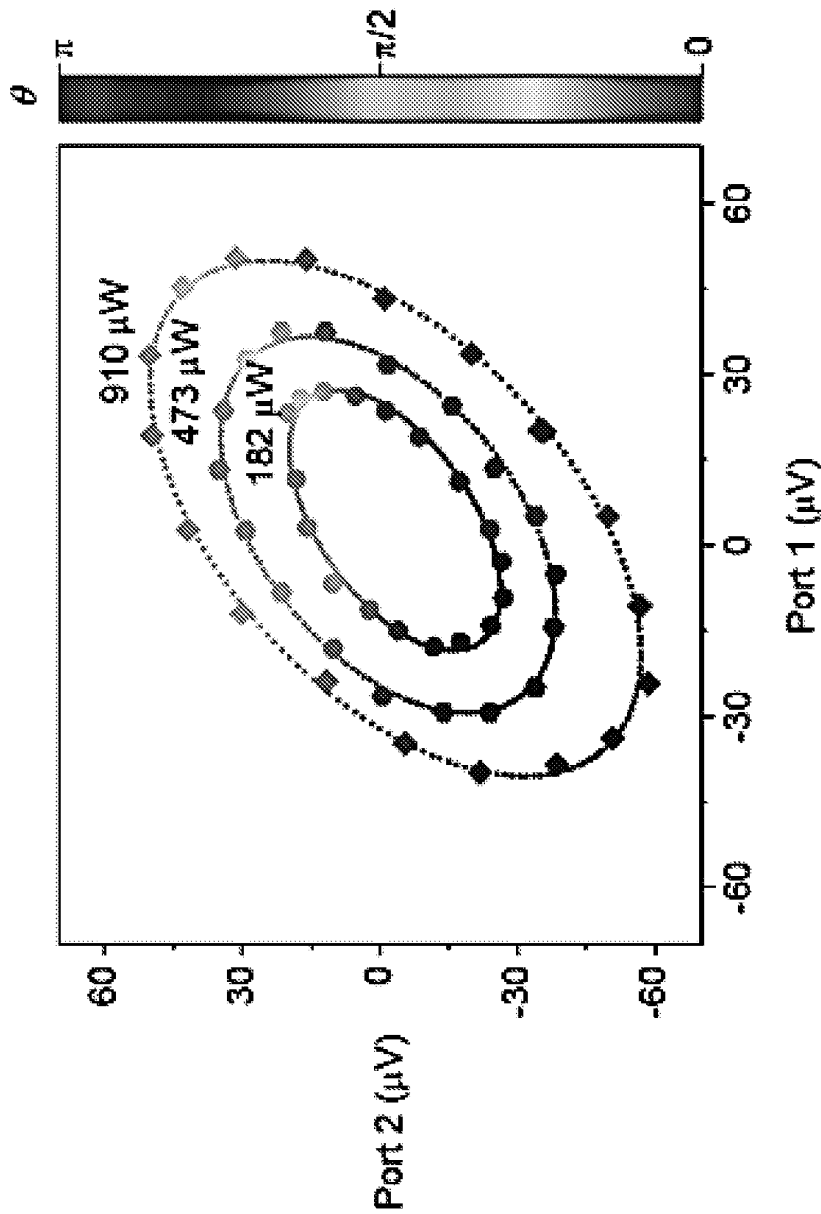


FIG. 36D

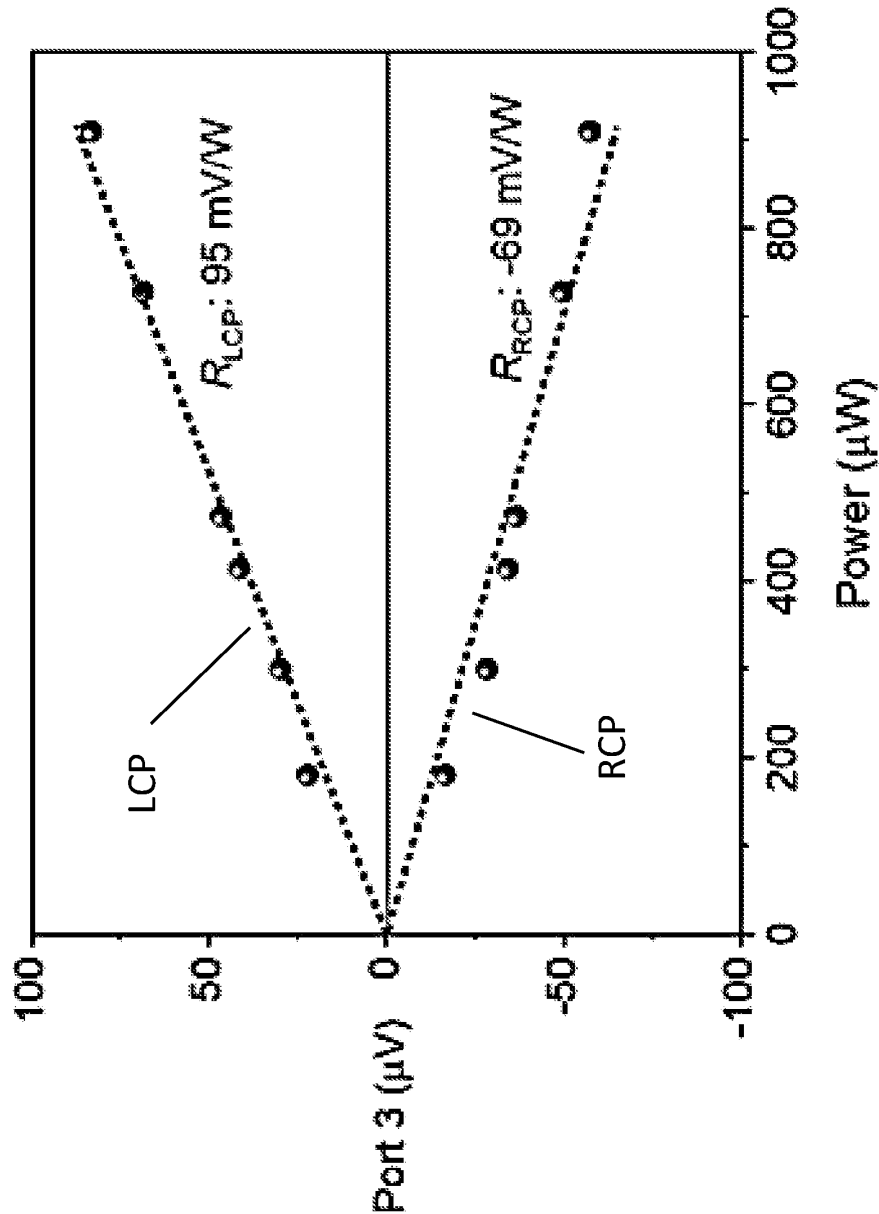


FIG. 37A

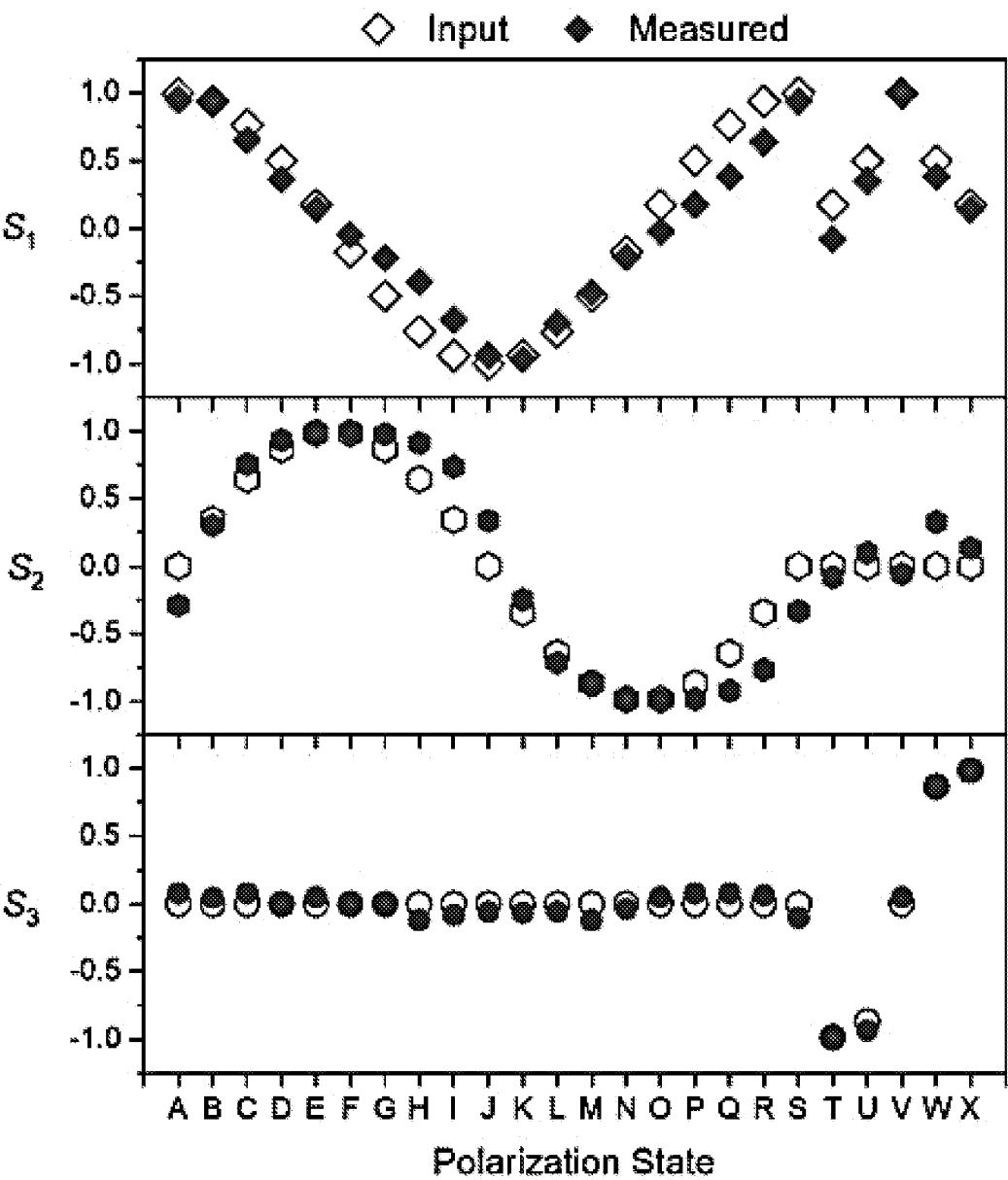


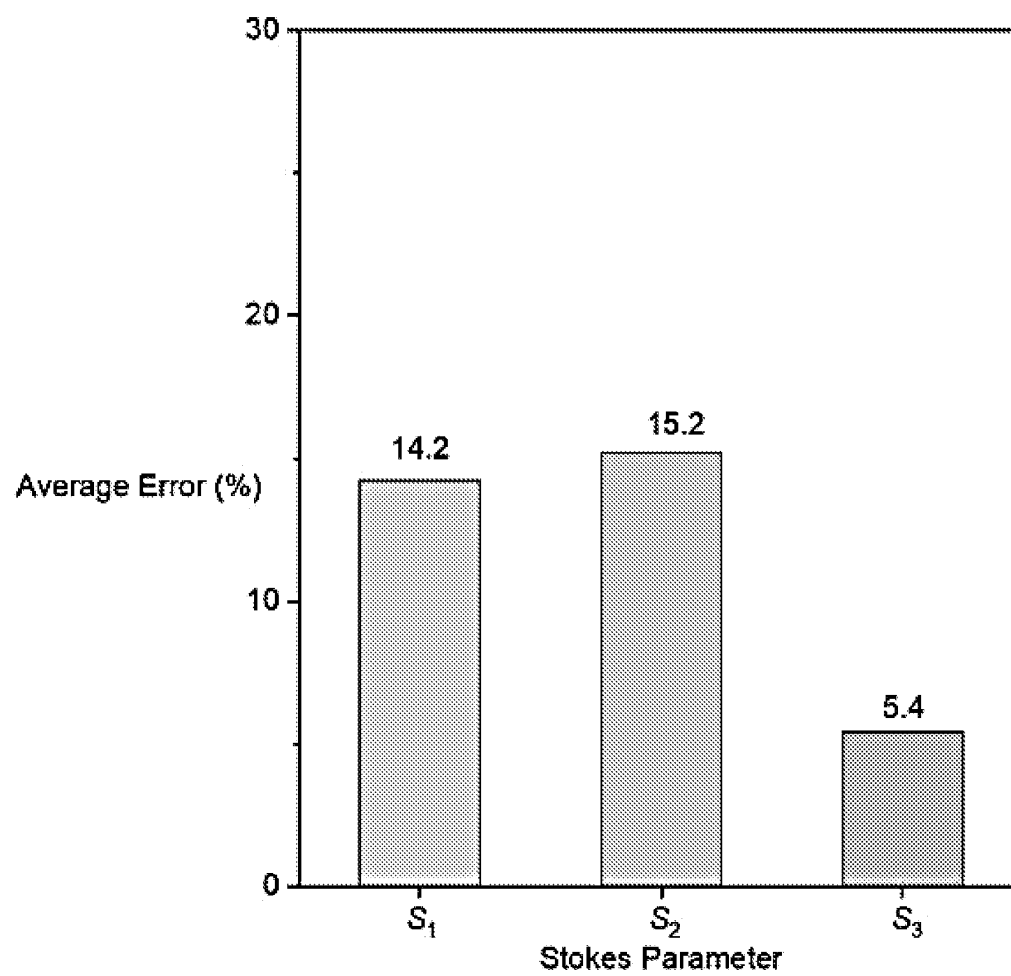
FIG. 37B

FIG. 38A

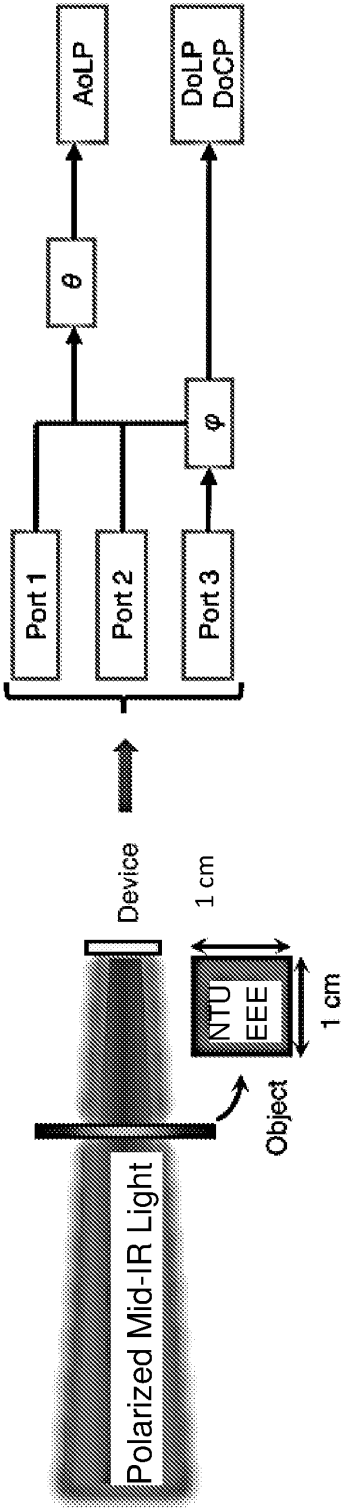


FIG. 38B

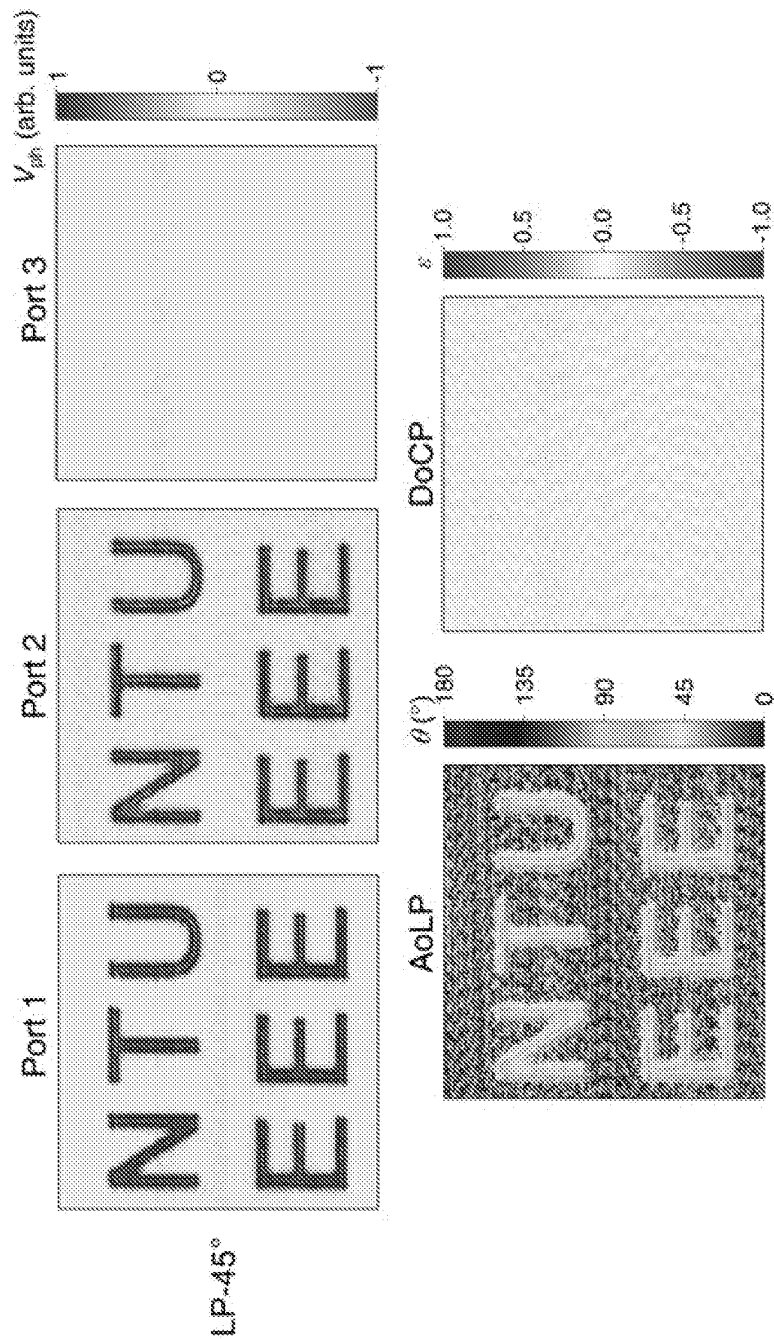


FIG. 38C

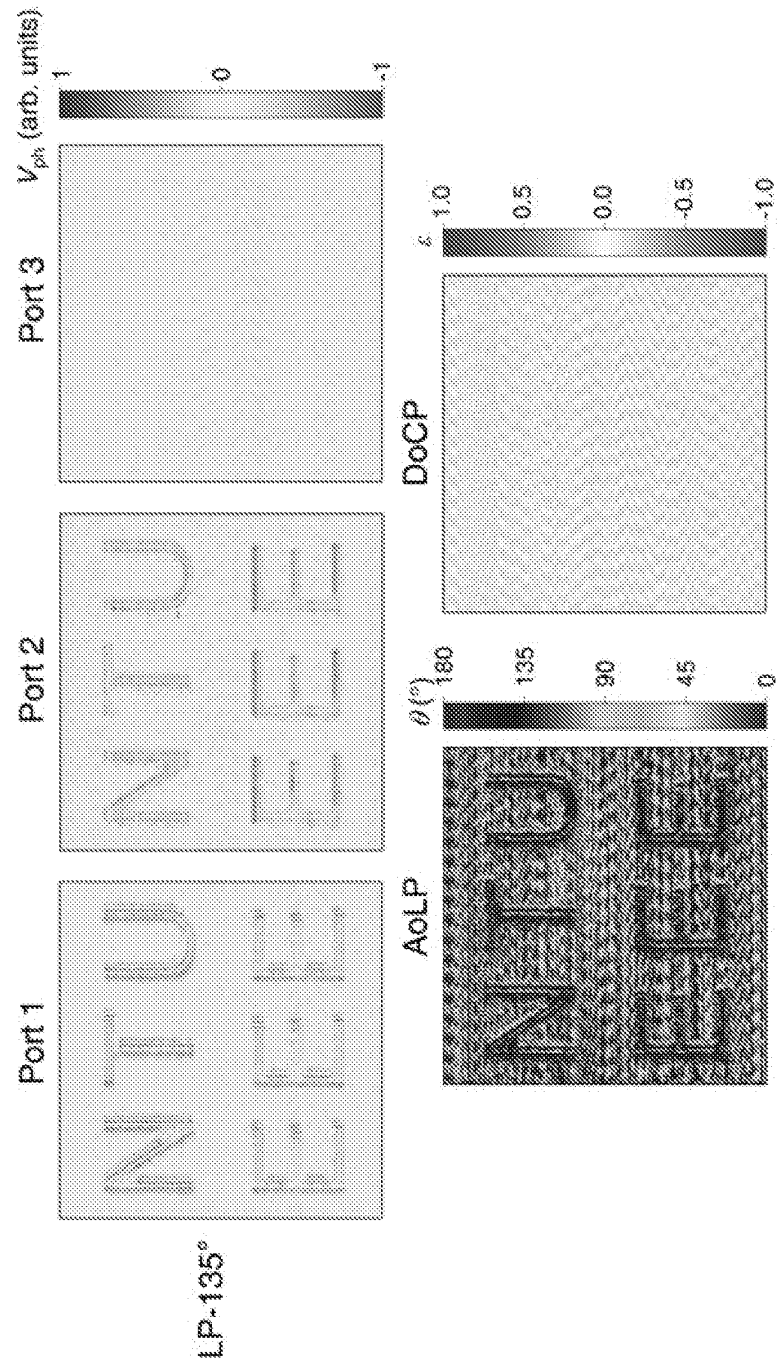


FIG. 38D

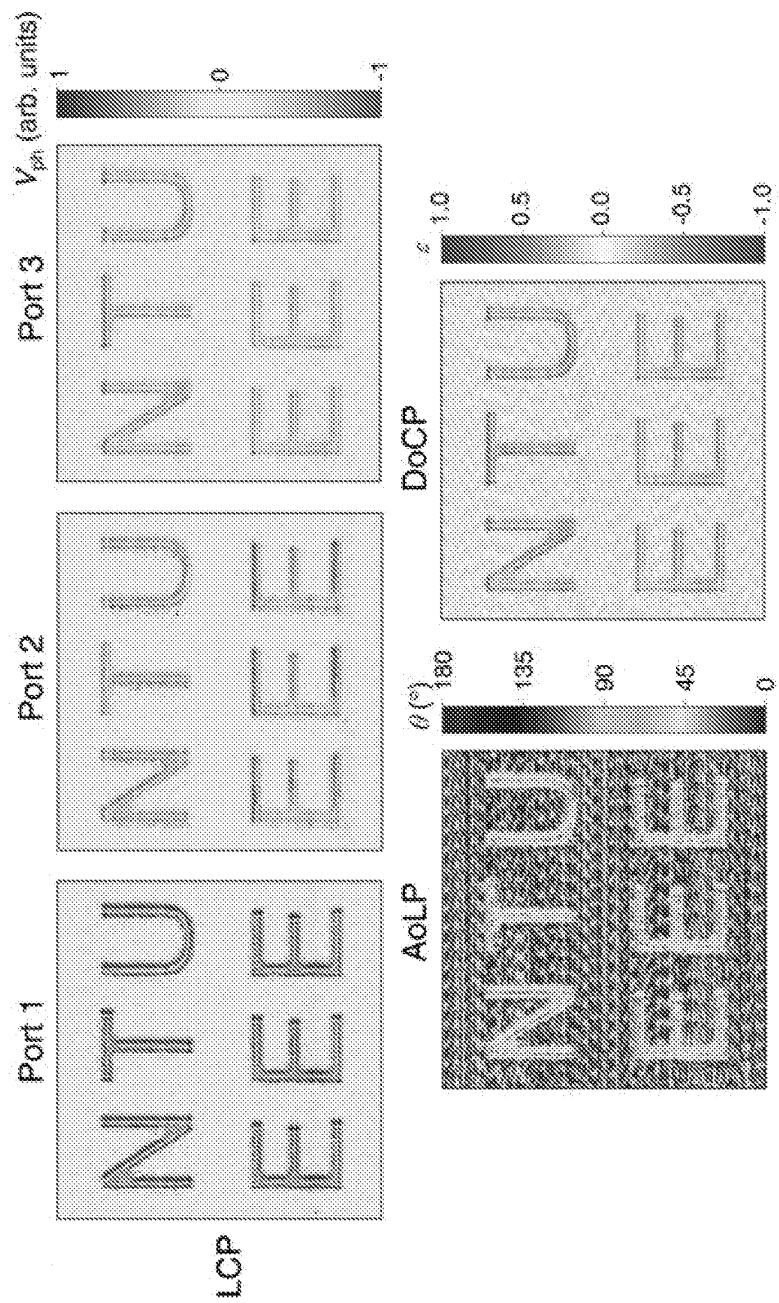


FIG. 38E

