MOLECULAR PROBES ON DIFFERENT SURFACES: SPECIAL CASES

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Colloidal properties and behaviors of 3 nm primary particles of detonation nanodiamonds in aqueous media†

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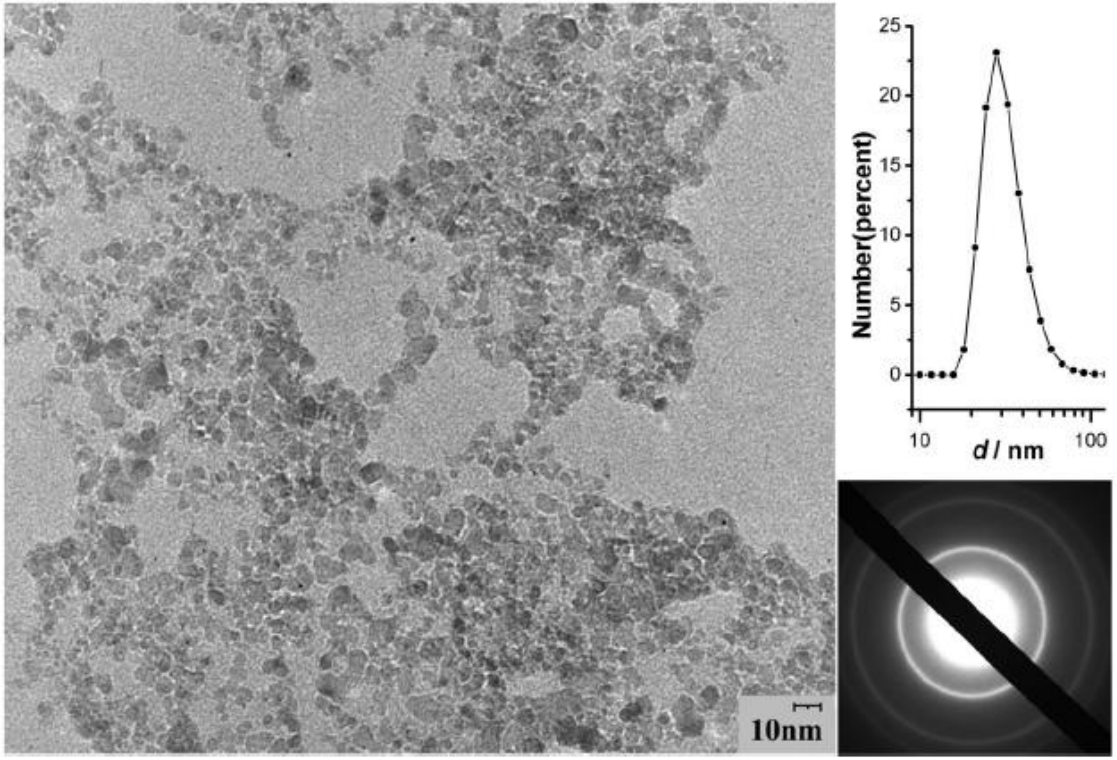
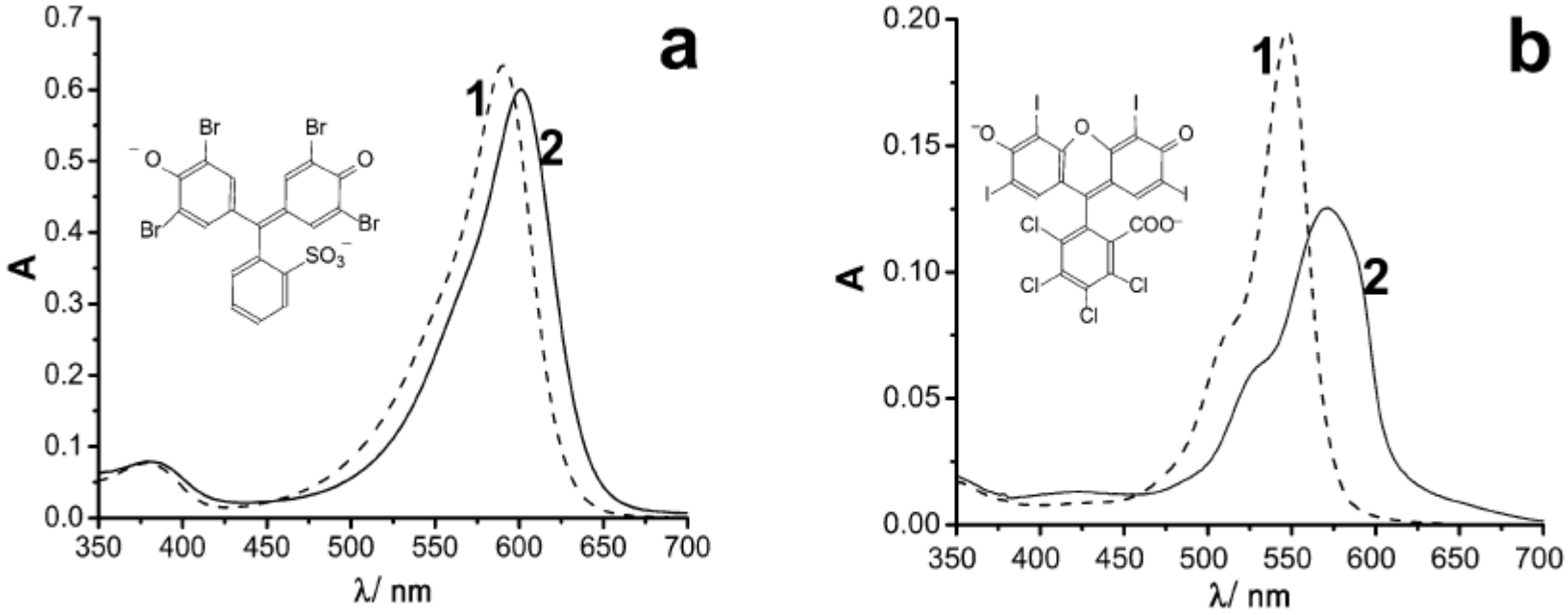




Bromophenol blue (a) and rose Bengal B (b) in water (1) and in ND 0.048% solution (2).

Table 2 The coagulation points, CCC/mM, of the 0.19% ND hydrosol

Electrolyte	CCC	z of the anion	CCC_{NaCl}:CCC
NaCl	2.8	−1	1.00
HCl	5.7	−1	0.49
$1/2CaCl_2$	2.4	−1	1.2
NaBr	2.5	−1	1.1
$C_{16}H_{33}N(CH_3)_3Br$	1.6	−1	1.75
$NaClO_4$	1.8	−1	1.6
KI	0.76	−1	3.7
NaOH	0.27	−1	10
$C_8H_{17}SO_3Na$	0.15	−1	19
$C_{12}H_{25}OSO_3Na$	0.039	−1	72
$C_{14}H_{29}OSO_3Na$	0.031	−1	90
$C_{16}H_{33}OSO_3Na$	0.041	−1	68
Na_2SO_4	0.17	−2	16
$K_3Fe(CN)_6$	0.014	−3	200
$K_4Fe(CN)_6$	0.0048	−4	583

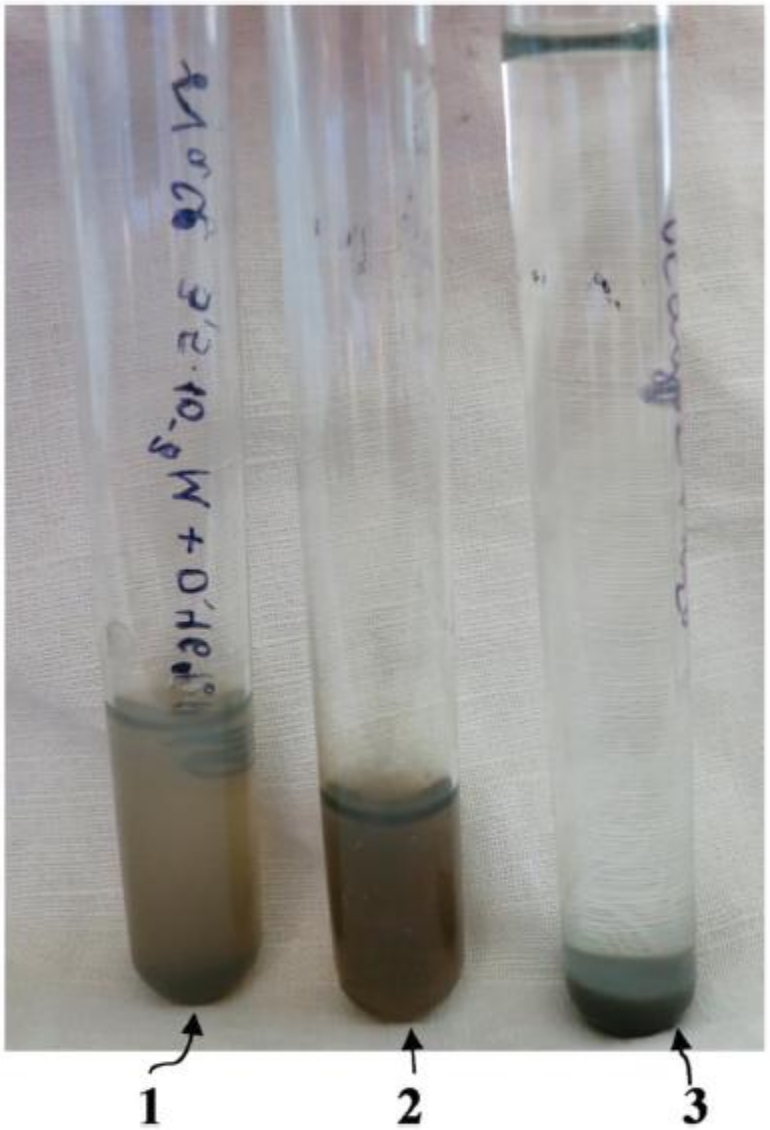


Fig. 10 The results of the peptization procedure: the 0.19% ND hydrosol, coagulated by NaCl (3.5×10^{-3} M) and then diluted by water (1); the initial hydrosol of the 0.19% ND (2); the same sol coagulated by NaOH (4.0×10^{-4} M) and diluted by an even larger portion of water (3). The samples (1) and (3) were shaken after dilution and left to remain 15 min before being photographed; after several days the picture remains unchanged.

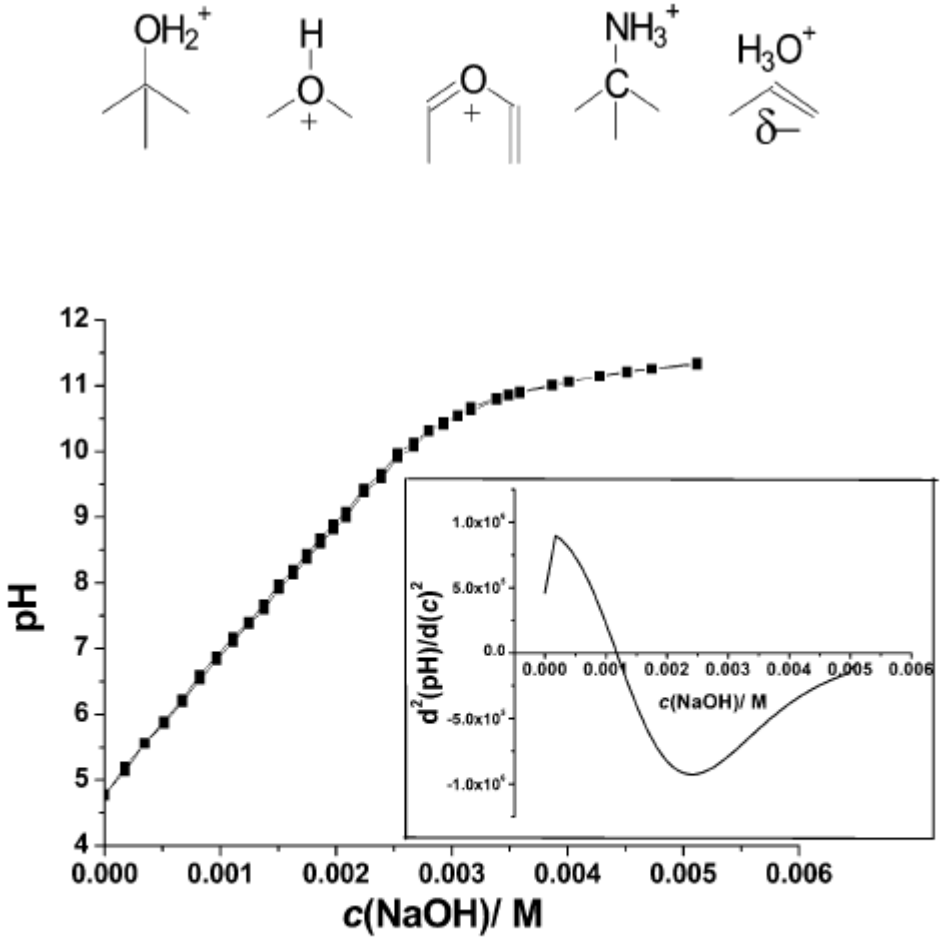


Fig. 11 The titration curve for 2.5% ND hydrosol with 0.00899 M NaOH solution; inset: the second derivative differential curve.

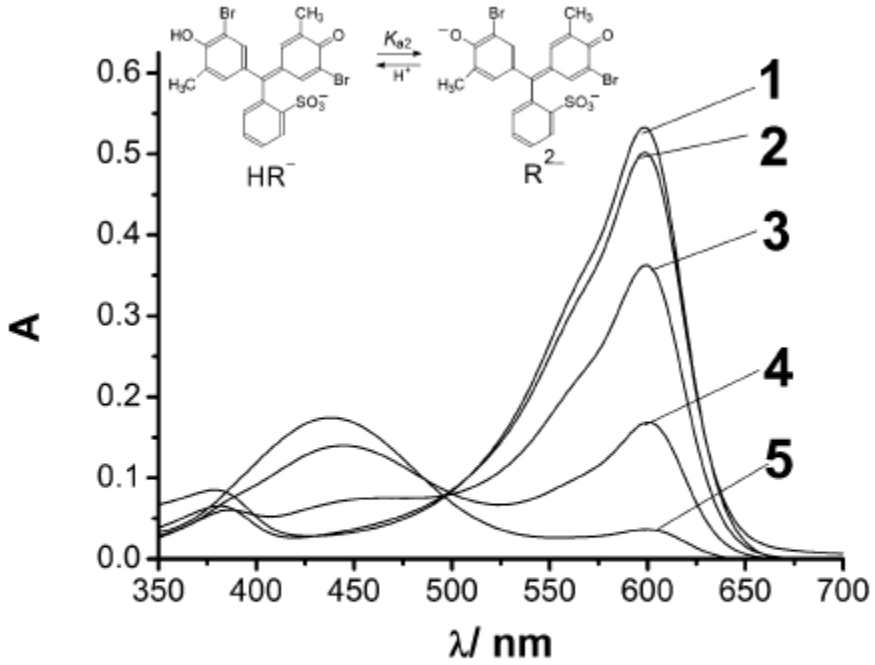


Fig. 12 The spectra of the indicator bromocresol purple at different pH values in 0.024% ND: the spectrum of R^{2-} with small NaOH addition, well below CCC (1); without HCl additions (2); with HCl additives, pH = 4.10 (3), 3.59 (4), and 3.04 (5).

$$\mathrm{p}K_{\mathrm{a}}^{\mathrm{app}} = \mathrm{p}K_{\mathrm{a}}^{\mathrm{i}} - \frac{\Psi F}{2.303RT}$$

$$\mathrm{p}K_{\mathrm{a}}^{\mathrm{app}} = \mathrm{pH} + \log\frac{[\text{acidic form}]}{[\text{basic form}]}$$

$$\Psi/\mathrm{mV} = 59.16\ (\mathrm{p}K_{\mathrm{a}}^{\mathrm{i}} - \mathrm{p}K_{\mathrm{a}}^{\mathrm{app}})$$

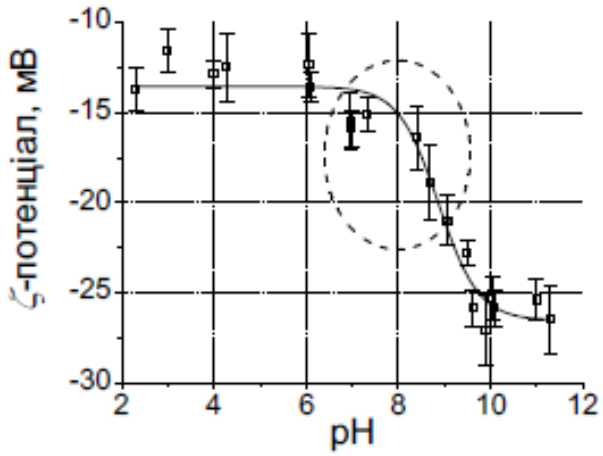
Table 3 The indices of the apparent ionization constants of the acid–base indicators, pK_a^{app}, and the estimates of the interfacial electrical potential, Ψ, in 0.024% ND sol

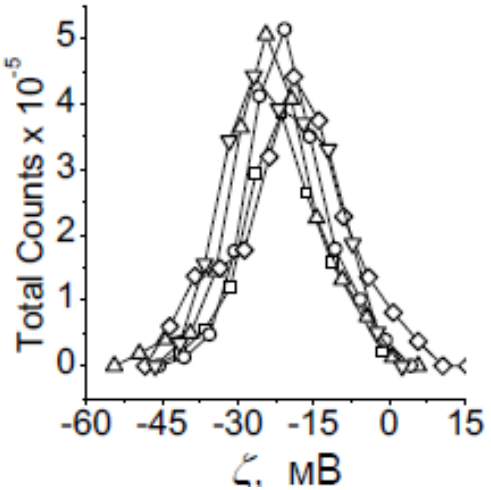
	$c(HCl) \times 10^4$/M				
	10.00	5.01	3.16	2.00	1.00
Indicators	pK_a^{app} [a] (Ψ/mV)				
Bromophenol blue [4.20][b]	2.35 (109)	—	—	—	—
Bromocresol green [4.90][b]	3.38 (90)	3.37 (90)	3.34 (92)	3.27 (96)	—
Bromocresol purple [6.40][b]	4.13 (134)	—	3.81 (153)	—	3.58 (167)
Sulfonefluorescein [6.76][b]	—	3.96 (166)	3.54 (190)	3.56 (189)	3.62 (186)
Average Ψ/mV	111	128	145	142	176

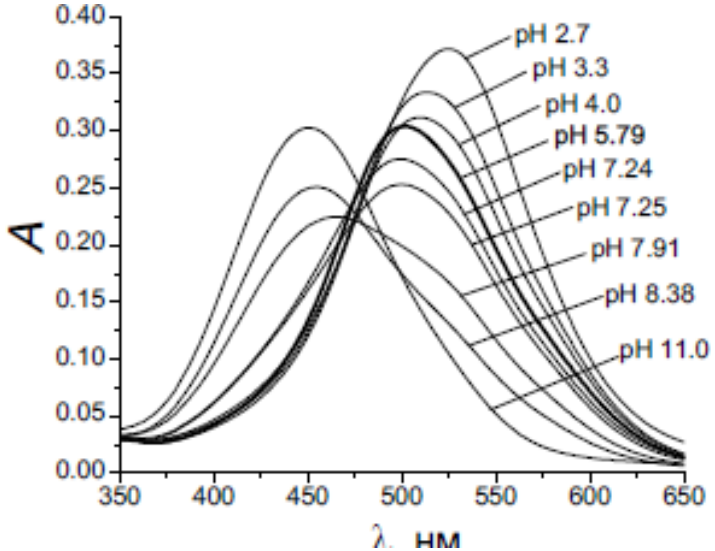
[a] 25 °C. [b] In the brackets, the pK_a^w values in water are given.

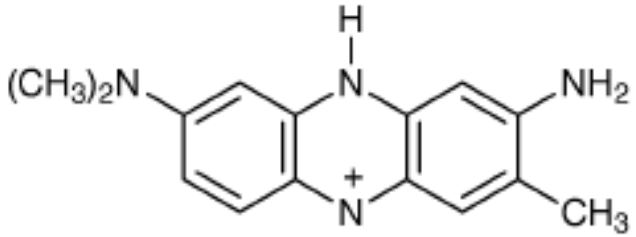
Залежність ζ-потенціалу агрегатів фулеренолу від pH при c ($C_{60}OH_{(18-22)}$) = 0,013 г/л та I = 0,005 М

pH	ζ-потенціал, мВ	pH	ζ-потенціал, мВ
2,3	–13,7±1,2	*продовження*	
3,0	–11,6±1,2	8,69	–18,9±2,1
4,0	–12,9±0,8	9,07	–21,0±1,4
4,27	–12,5±1,9	9,5	–22,8±0,7
6,07	–12,4±1,8	9,62	–25,9±1,0
6,1	–13,6±0,8	9,91	–27,1±2,0
6,97	–15,5±1,6	10,05	–25,3±1,2
6,99	–15,9±1,0	10,1	–25,9±1,0
7,34	–15,1±1,0	11,0	–25,4±1,1
8,40	–16,4±1,8	11,3	–26,5±1,9







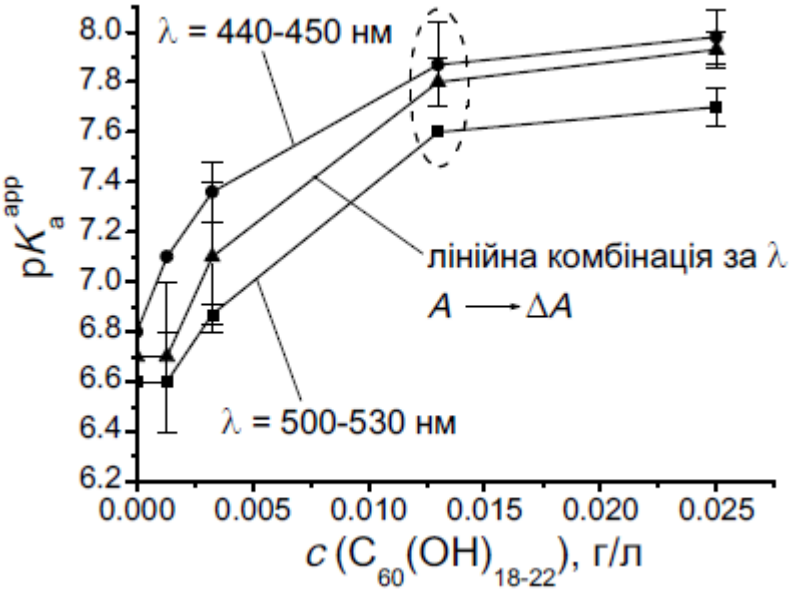


Neutral Red cation, HR^+

$$RH^+ \rightleftharpoons R + H^+$$

$c(C_{60}OH_{(18\text{-}22)})$, г/л	pK_a^{app}	(λ, нм)	pK_a^{app}	(λ, нм)	pK_a^{app} за ΔA
0	6,6	(530)	6,8	(450)	6,7
0,0013	6,6±0,2	(530)	7,1	(450)	6,7±0,3
0,0033	6,87±0,04	(528)	7,36±0,12	(450)	7,1±0,3
0,013	7,6	(504)	7,87±0,17	(450)	7,8±0,1
0,025	7,7±0,08	(510)	7,98±0,11	(440)	7,93±0,07

$$\Psi = 59.16(6.7-7.9) = -71(\text{mV})$$


λ = 440-450 нм
лінійна комбінація за λ
A ⟶ ΔA
λ = 500-530 нм
8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
0.000
0.005
0.010
0.015
0.020
0.025
pK_a^app
c (C60(OH)18-22), г/л

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Surface-Enhanced Raman Spectroscopy Investigation of the Potential-Dependent Acid−Base Chemistry of Silver-Immobilized 2-Mercaptobenzoic Acid

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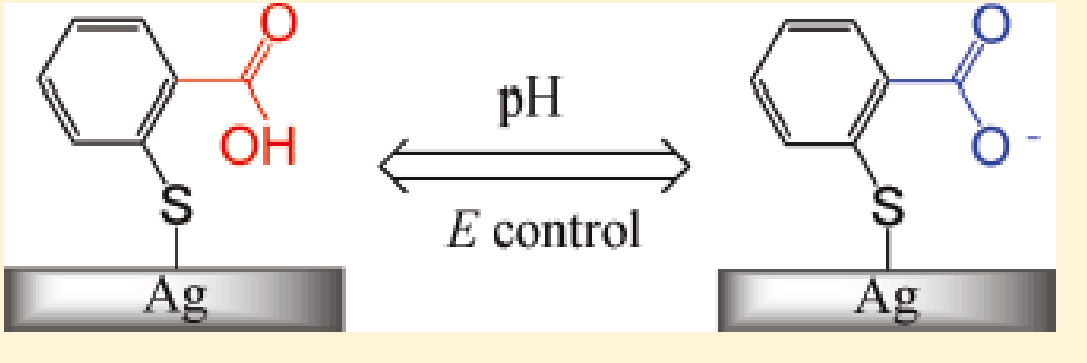

$$\mathrm{pH} = \mathrm{p}K_a + \log\frac{\beta}{1-\beta} + \frac{\overline{E}\beta}{2.303RT}$$

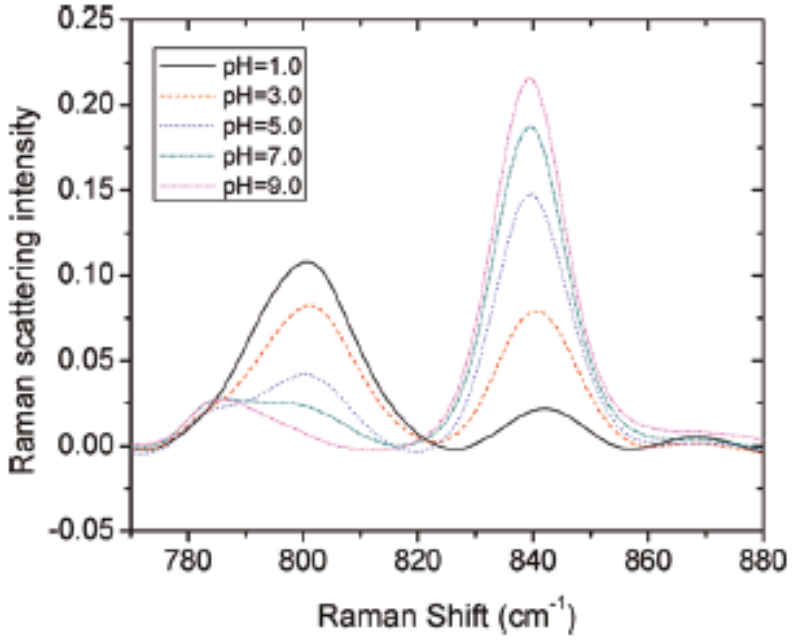

Figure 3. SERS spectra of 2-MBA in different solution pH with applied potential = −0.4 V (versus Ag/AgCl).

$$\beta = \frac{[-\mathrm{COO}^-]}{[-\mathrm{COO}^-] + [-\mathrm{COOH}]} = \frac{I_{840}^{\mathrm{rel}}}{I_{840}^{\mathrm{rel}} + I_{800}^{\mathrm{rel}}}$$

$$a_{\mathrm{interface}} = a_{\mathrm{bulk}} \exp(-zF\Phi_o/RT)$$

$$RCOO^- + H^+ \leftrightarrow RCOOH$$

$$pH_{interface} = pH_{bulk} + \frac{F}{2.303RT}\Phi_x$$

$$pK_{a,x} = pK_{a,0} - \frac{F}{2.303RT}\Phi_x$$