Qualitative Analysis of Anions. Cathodic Stripping Voltammetry of Anions

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Tests:

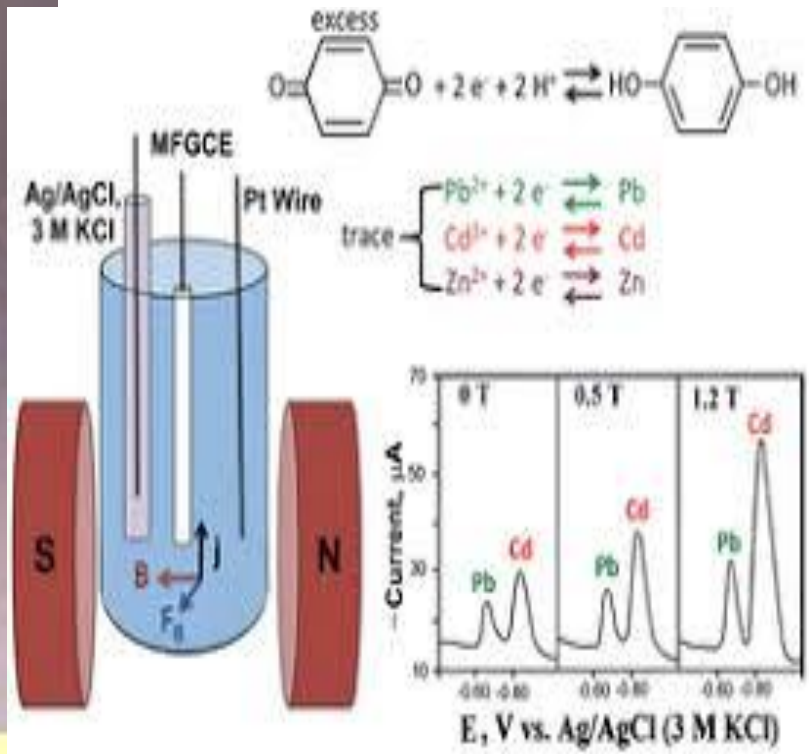
Cl^- (Chloride Ion)

SO_4^{2-} (Sulfate Ion)

NO_3^- (Nitrate Ion)

CO_3^{2-} (Carbonate Ion)

PO_4^{3-} (Phosphate Ion)



Квалитативна анализа на анјоните I група

Anion	$BaCl_2$ reagent	ph.ph. test	$AgNO_3$ reagent
CO_3^{2-}	Бел талог од $BaCO_3$ $CO_3^{2-} + Ba^{2+} = BaCO_3 \downarrow$	Pink colored solution	Бел талог од Ag_2CO_3 се претвора во темен со вишок на реагенс $CO_3^{2-} + 2Ag^+ = Ag_2CO_3 \downarrow$
HCO_3^-	Бел талог од $BaCO_3$ при Загревање се раствара $2HCO_3^- + Ba^{2+}$ $= BaCO_3 \downarrow + CO_2 \uparrow + H_2O$	Colorless solution	- Ve
SO_3^{2-}	Бел талог од $BaSO_3$ $SO_3^{2-} + Ba^{2+} = BaSO_3 \downarrow$	Alkaline to litmus paper 	Бел кристален талог од Ag_2SO_3 Што се раствора во вишок реагенс $SO_3^{2-} + 2Ag^+ = Ag_2SO_3 \downarrow$
$S_2O_3^{2-}$	Бел талог од BaS_2O_3 $S_2O_3^{2-} + Ba^{2+} = BaS_2O_3 \downarrow$		Бел талог од Ag_2SO_3 што пожолтува со вишок на реагенс $S_2O_3^{2-} + 2Ag^+ = Ag_2S_2O_3 \downarrow$ $Ag_2S_2O_3 \downarrow + H_2O = Ag_2S \downarrow + SO_4^{2-}$
S^{2-}	- Ve		црн талог од $Ag_2S \downarrow$ $2Ag^+ + S^{2-} = Ag_2S \downarrow$
NO_2^-	- Ve 		Бел кристален талог од $AgNO_2$ $Ag^+ + NO_2^- = AgNO_2 \downarrow$

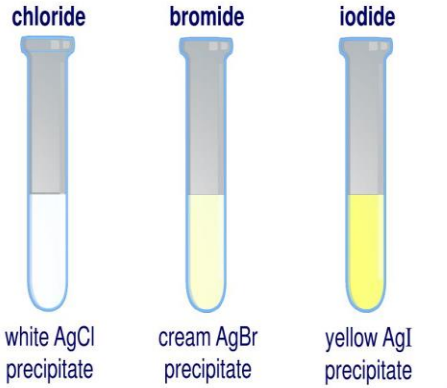
Квалитативна анализа на анјоните II група

Оловен ацетат реагенс

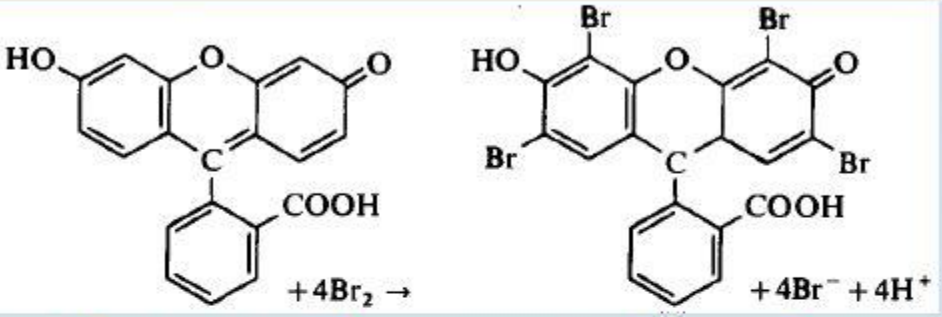
Anion	$AgNO_3$ reagent	
F^-	-Ve	-Ve
Cl^-	Бел волуминозен талог AgCl Што се раствора во амонијак $Cl^- + Ag^+ = AgCl \downarrow$	Бел волуминозен талог $PbCl_2$ Што се раствора во топла вода $2Cl^- + Pb^{+2} = PbCl_2 \downarrow$
Br^-	Жолт волуминозен талог AgBr Што се раствора во конц. амонијак $Br^- + Ag^+ = AgBr \downarrow$	Бел кристален талог $PbBr_2$ Што добро се раствора во топла вода $2Br^- + Pb^{+2} = PbBr_2 \downarrow$
I^-	Жолт волуминозен талог AgI што НЕ се раствора во. амонијак $I^- + Ag^+ = AgI \downarrow$	Златно Жолт кристален талог PbI_2 $2I^- + Pb^{+2} = PbI_2 \downarrow$
NO_3^-	- Ve	

Silver halides

The different silver halide precipitates can be distinguished by their differing colours.

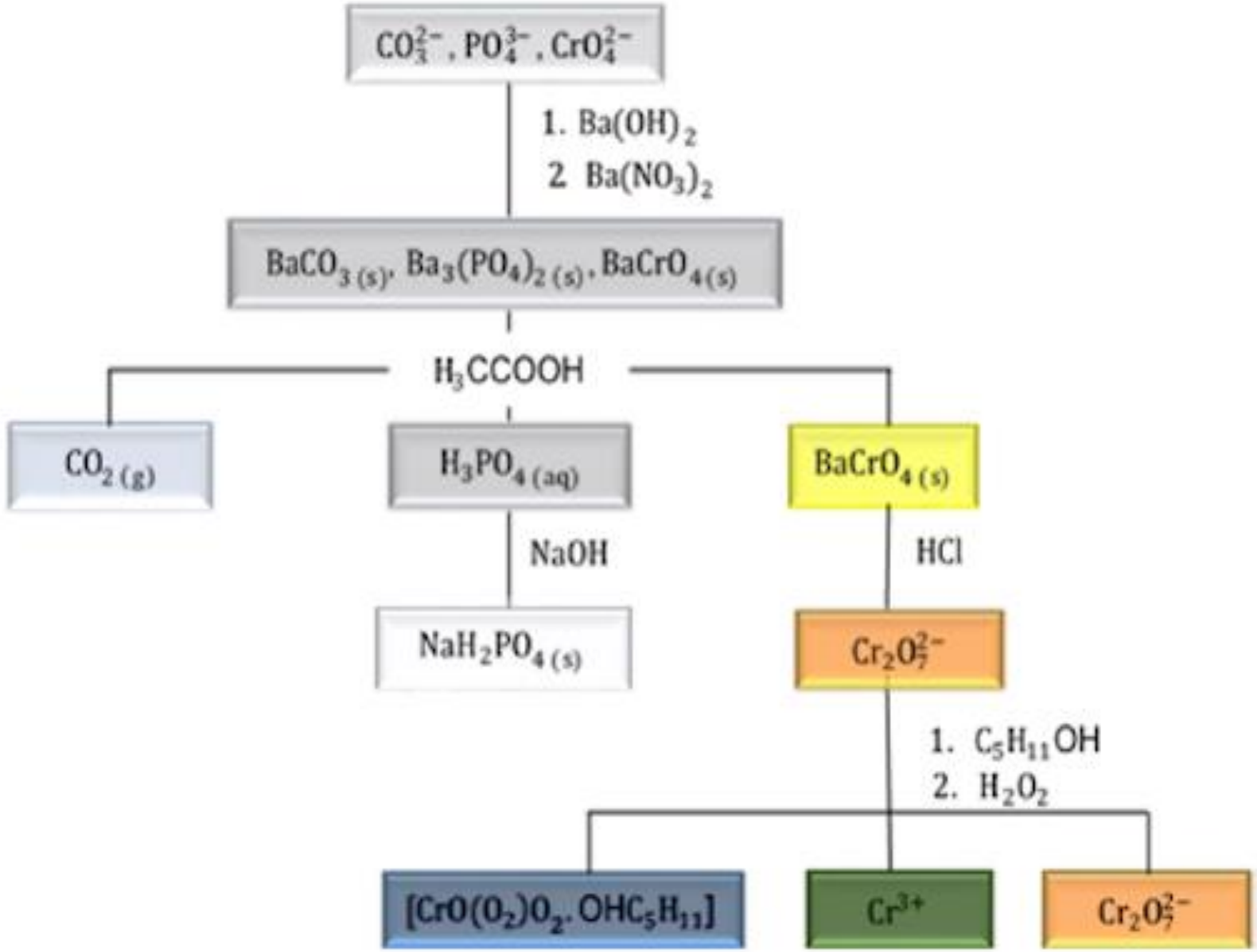


Квалитативна анализа на анјоните II група

Anion	Специфични реакции
Br^-	**Fluorescein test**  жолт fluorescein → црвен eosin
I^-	**$CuSO_4$ test** Се формира кафеав талог од Cu_2I_2 И од $(4I^- + 2Cu^{+2} = Cu_2I_2 \downarrow + I_2)$ **$HgCl_2$ test** Се формира црвенкав талог од HgI_2 Што се раствора во вишок на јодиди $2I^- + HgCl_2 = HgI_2\downarrow + 2Cl^-$
NO_3^- 	Тест со формирање на кафеав прстен $FeSO_4$ (25% saturated solution) + NO_3^- (solution) + conc. H_2SO_4 (slowly down the side of test tube) →brown ring is formed temporarily at the junction of the 2 liquids $2NO_3^- + 6Fe^{2+} + 8H^+ = 6Fe^{3+} + 2NO\uparrow + 4H_2O$ $NO\uparrow + FeSO_4 = [Fe, NO]SO_4$ (brown ring)

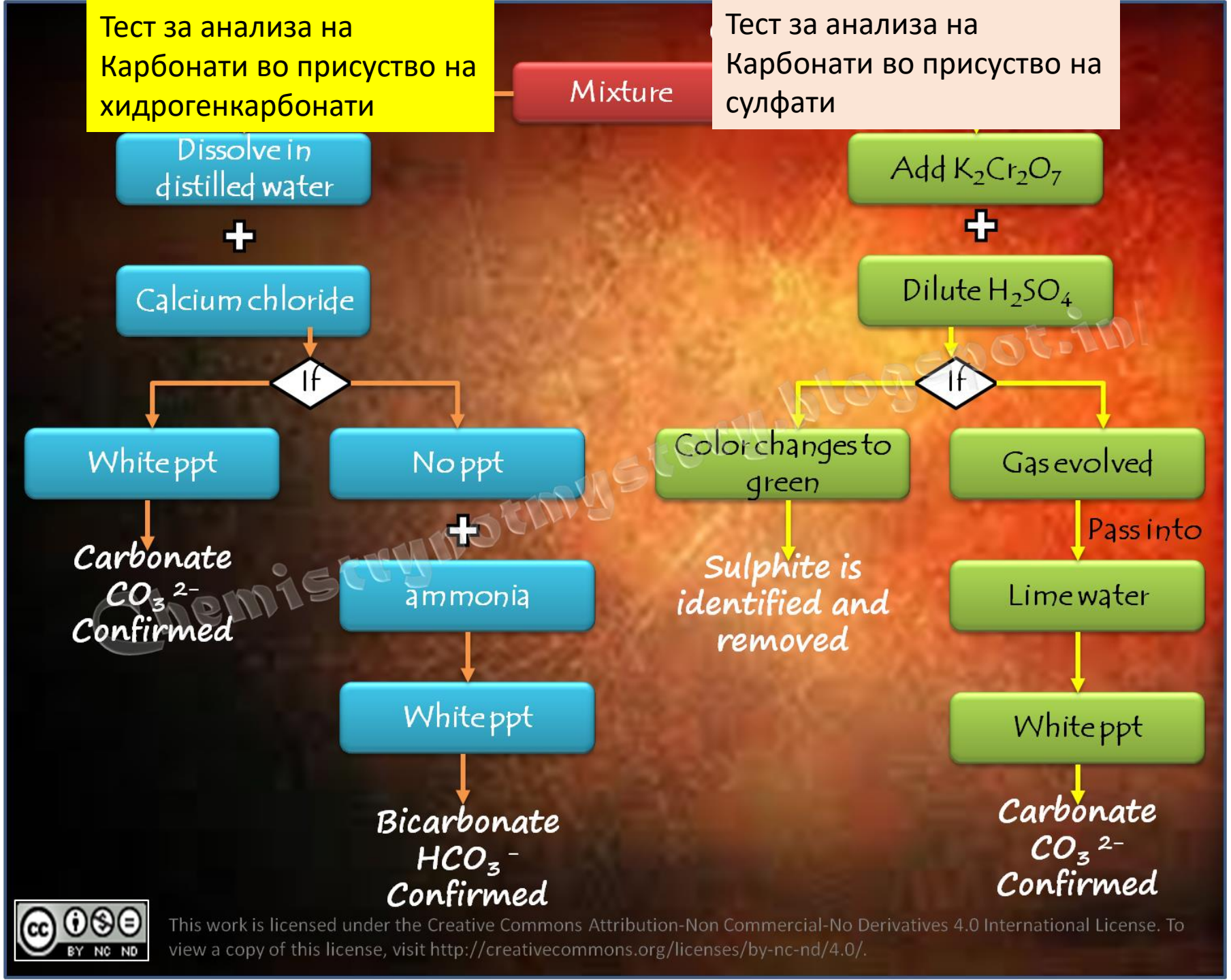
Квалитативна анализа на анјоните III група

Anion	$AgNO_3$ reagent	$BaCl_2$ reagent	Оловен ацетат реагенс
SO_4^{2-}	Бел кристален талог од Ag_2SO_4 $SO_4^{-2} + 2Ag^+ = Ag_2SO_4 \downarrow$	Бел талог од $BaSO_4$ Нерастворлив во HCl и во HNO_3 $SO_4^{-2} + Ba^{+2} = BaSO_4 \downarrow$	Бел талог од $PbSO_4$ РАСТВОРЛИВ во Конц H2SO4 и во амониум ацетат $SO_4^{-2} + Pb^{+2} = PbSO_4 \downarrow$
PO_4^{3-}	жолт талог од Ag_3PO_4 РАСТВОРЛИВ во разредена HNO3 и во амонијак $PO_4^{-3} + 3Ag^+ = Ag_3PO_4 \downarrow$	Бел талог од $BaHPO_4$ РАСТВОРЛИВ во разредени Минерални киселини и во амонијак $HPO_4^{-2} + Ba^{+2} = BaHPO_4 \downarrow$	-Ve

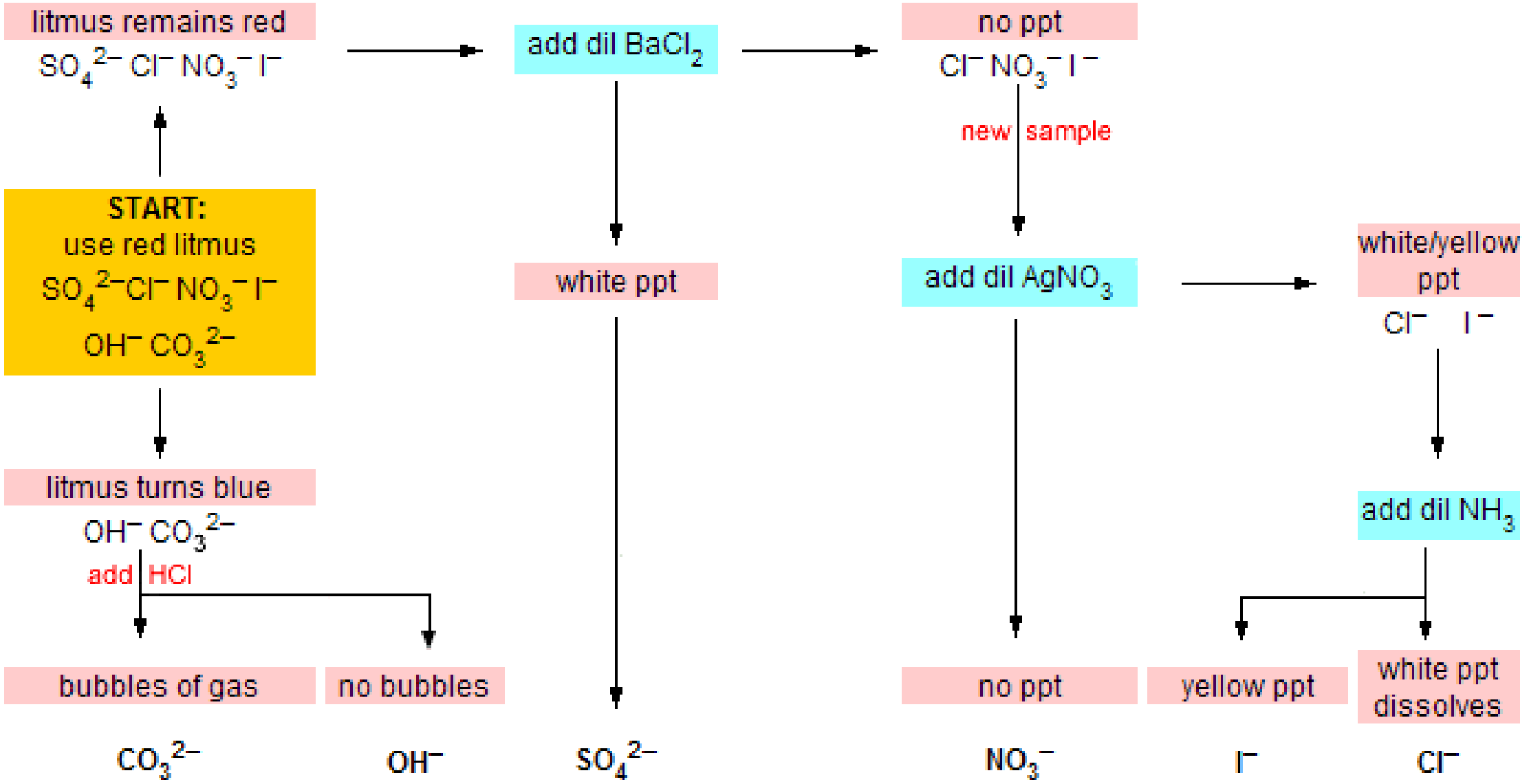

CO_3^{2-}, PO_4^{3-}, CrO_4^{2-}
1. $Ba(OH)_2$
2 $Ba(NO_3)_2$
$BaCO_{3\,(s)}$, $Ba_3(PO_4)_{2\,(s)}$, $BaCrO_{4\,(s)}$
H_3CCOOH
$CO_{2\,(g)}$
$H_3PO_{4\,(aq)}$
$BaCrO_{4\,(s)}$
NaOH
HCl
$NaH_2PO_{4\,(s)}$
$Cr_2O_7^{2-}$
1. $C_5H_{11}OH$
2. H_2O_2
$[CrO(O_2)O_2.OHC_5H_{11}]$
Cr^{3+}
$Cr_2O_7^{2-}$

Тестирања за поединечно докажување на анјони

Anion	Test	Result
Carbonate(CO_3^{2-})	Add dilute acid	CO_2 produced makes limewater cloudy
Chloride(Cl^-)	Add nitric acid, then add aqueous silver nitrate	White ppt.
Bromide(Br^+)		Cream ppt.
Iodide(I^-)		Yellow ppt
Nitrate(NO_3^-)	Add aqueous sodium hydroxide then add aluminium	Ammonia produced turns damp **red** litmus paper **blue**
Sulfate(SO_4^{2-})	Add nitric acid, then add aqueous barium nitrate	White ppt.
Sulfite(SO_3^{2-})	Add dilute HCl, warm gently	SO_2 produced turns acidified potassium manganate from **purple** to colourless



ПОСТАПКА ЗА СИСТЕМАТСКА АНАЛИЗА НА АНЈОНИТЕ КОГА СЕ ВО СМЕСА

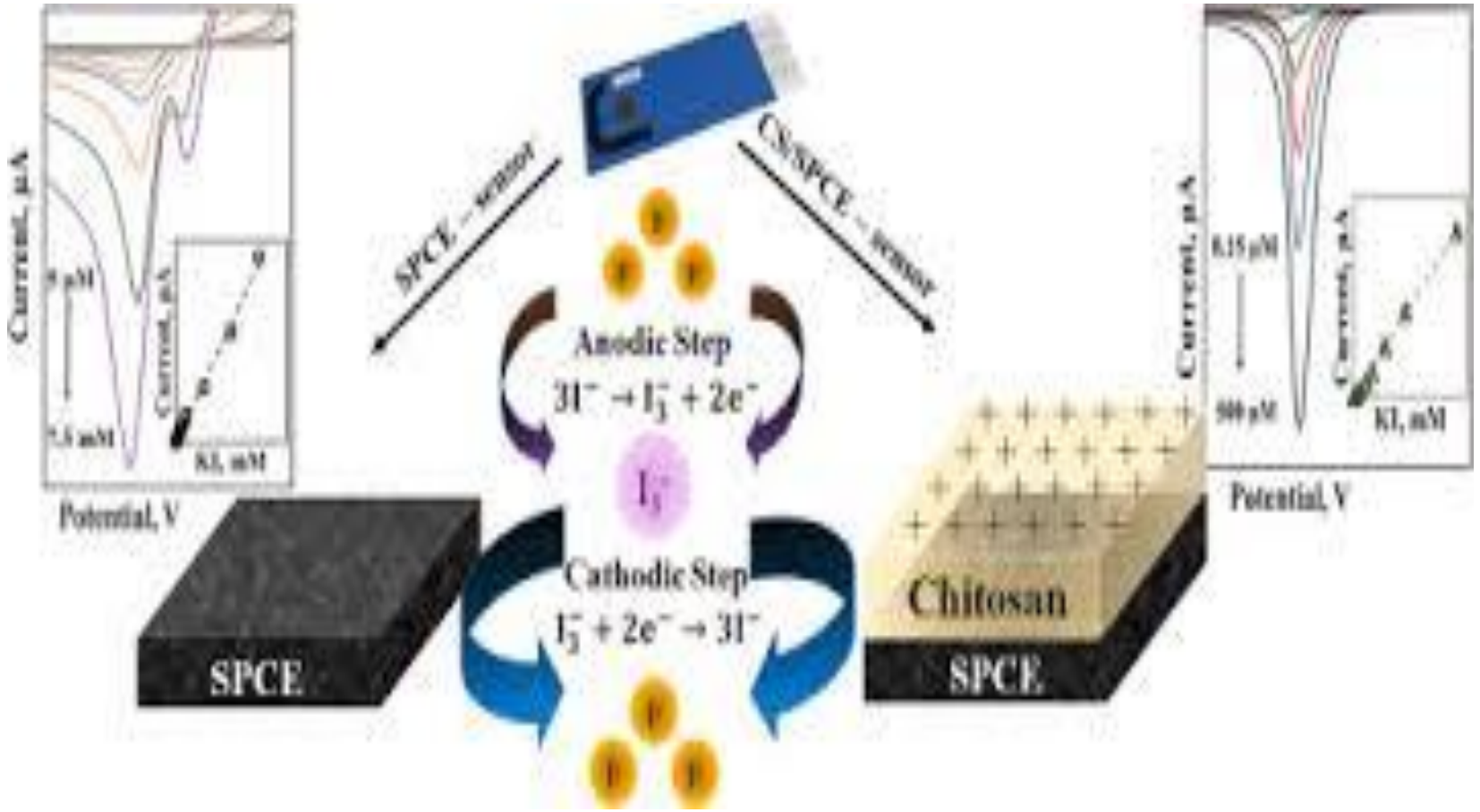


ТЕСТОВИ ЗА ДОКАЖУВАЊЕ НА ГАСОВИ

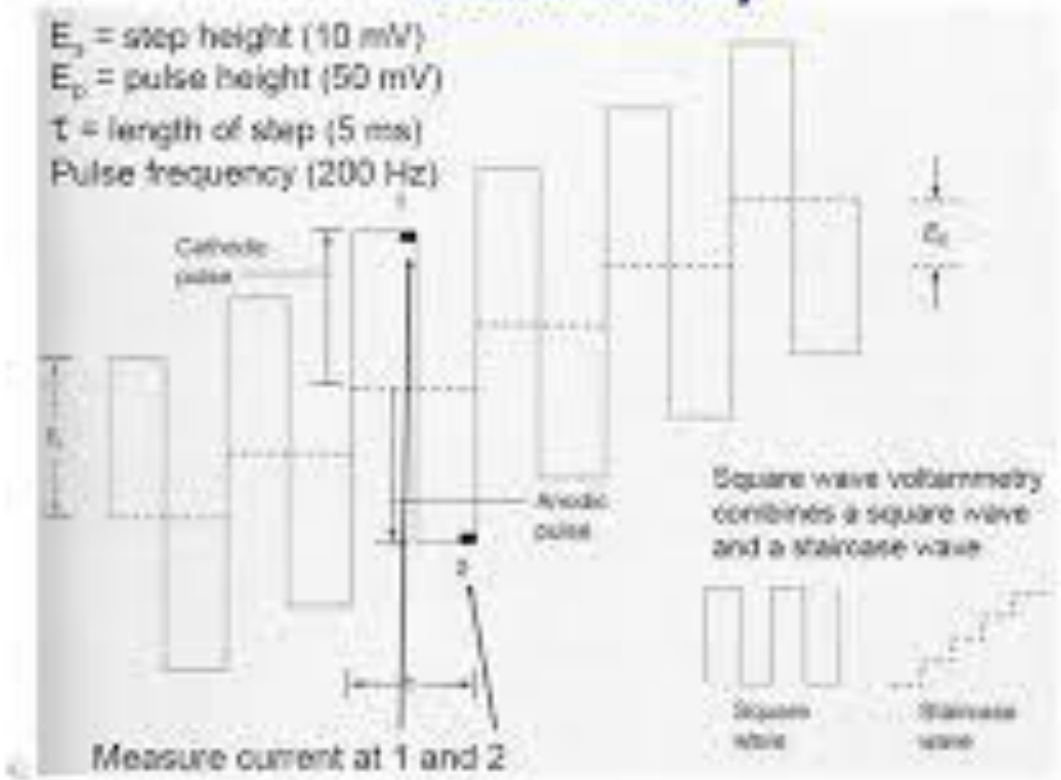
Gases	Colour and Smell	Test	Test Result
Ammonia	Colourless, pungent	Hold damp red litmus paper in gas	Paper turns blue
Carbon dioxide	Colourless, odourless	Bubble gas through limewater	White ppt
Chlorine	Pale green, choking smell	Hold damp litmus paper in gas	Paper is bleached white
Hydrogen	Colourless, odourless	Hold a lighted splint in gas	Burns with a squeaky pop
Oxygen	Colourless, odourless	Hold a glowing splint in gas	The splint re-lights
Sulfur Dioxide	Colourless, choking smell	Bubble gas through acidified aqueous potassium manganate(VII)	Potassium manganate (VII) change from **purple** to colourless

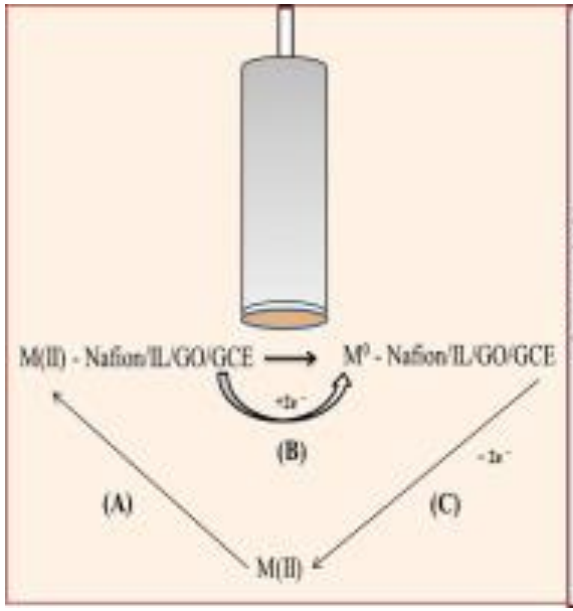
	Solution	PO_4^{3-}	SO_4^{2-}	CO_3^{2-}	OH^-	Cl^-	Br^-	I^-	CH_3COO^-
Ba^{2+}	Colourless	White insoluble			White slightly soluble	White soluble	White soluble	White soluble	White soluble
Ca^{2+}		White insoluble	White slightly soluble	White insoluble	White slightly soluble	White soluble	White soluble	White soluble	White soluble
Mg^{2+}		White insoluble	White soluble	White insoluble	White insoluble	White soluble	White soluble	White soluble	White soluble
Pb^{2+}		White insoluble			White insoluble	White slightly soluble		Yellow insoluble	White soluble
Cu^{2+}	Blue	Blue insoluble	Blue soluble	Green insoluble	Blue insoluble	Blue soluble	Blue soluble	Not stable	Blue soluble
Fe^{2+}	Pale green	Green insoluble	Green soluble	Grey insoluble	Green insoluble	Green soluble	Green soluble	Green soluble	Green soluble
Fe^{3+}	Yellow	Yellow insoluble	Yellow soluble	Not stable	Brown insoluble	Brown soluble	Brown soluble	Not stable	Brown slightly soluble
Ag^+	Colourless	Yellow insoluble	White slightly soluble	Yellow insoluble	Not stable	White insoluble	Yellow insoluble		White slightly soluble

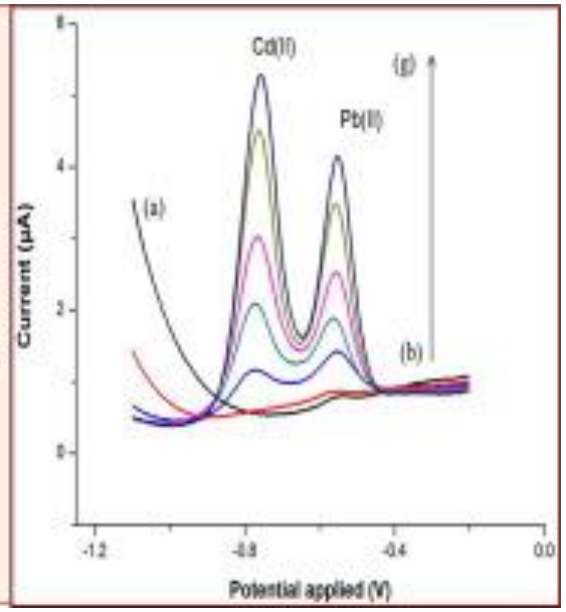
CATHODIC STRIPPING VOLTAMMETRY OF ANIONS AT MERCURY ELECTRODE

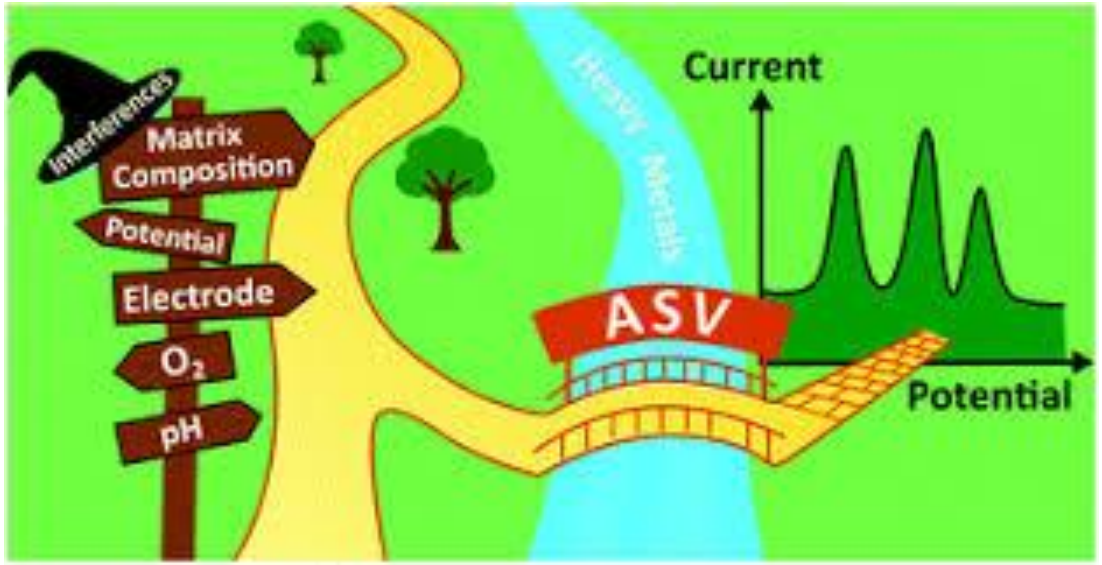


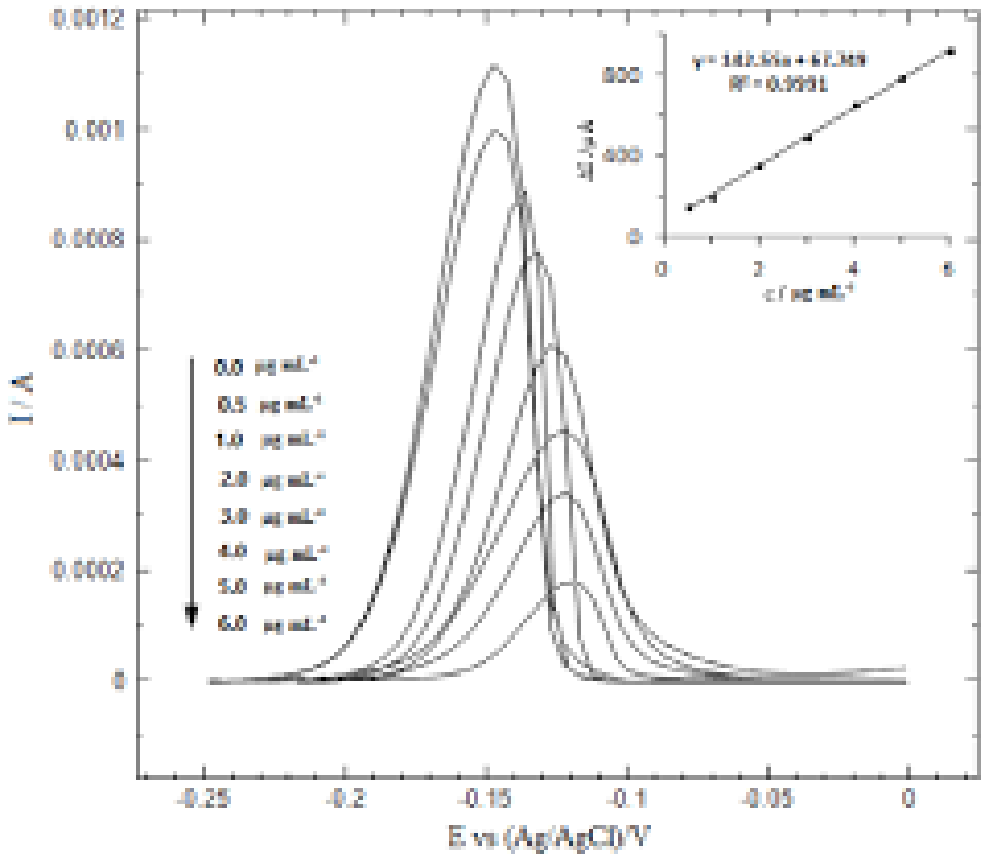
Square Wave Cathodic stripping Voltammetry

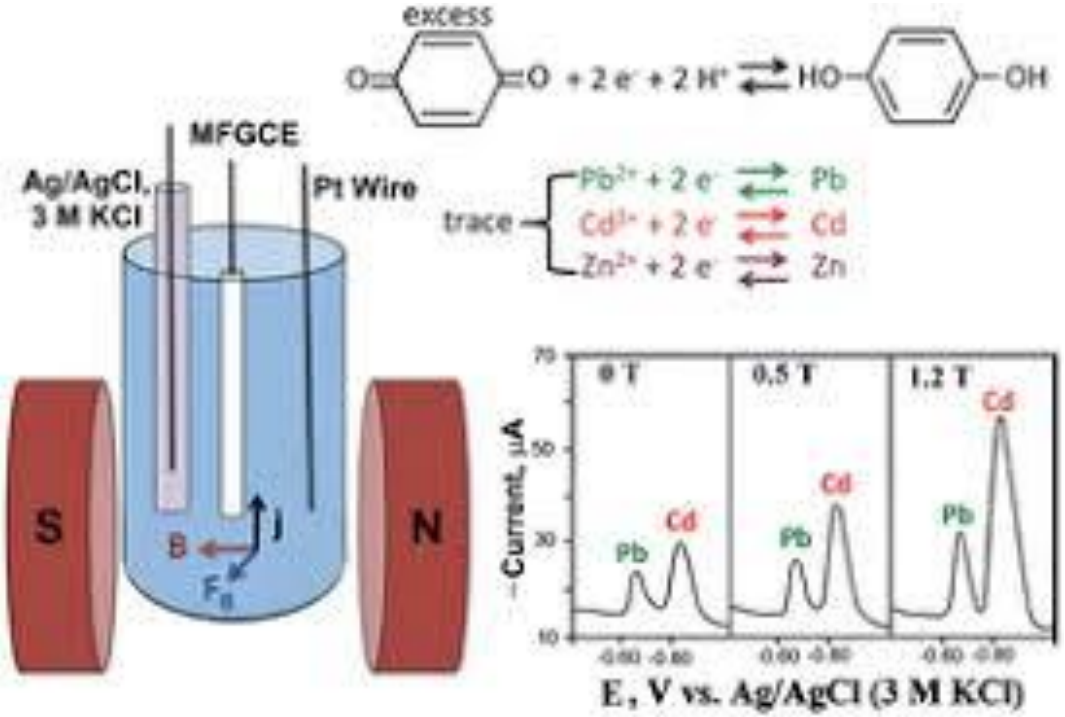









I / A
E vs (Ag/AgCl)/V
0.0 µg mL⁻¹
0.5 µg mL⁻¹
1.0 µg mL⁻¹
2.0 µg mL⁻¹
3.0 µg mL⁻¹
4.0 µg mL⁻¹
5.0 µg mL⁻¹
6.0 µg mL⁻¹


excess
+ 2 e⁻ + 2 H⁺
HO
OH
MFGCE
Ag/AgCl,
3 M KCl
Pt Wire
trace
Pb²⁺ + 2 e⁻ ⇌ Pb
Cd²⁺ + 2 e⁻ ⇌ Cd
Zn²⁺ + 2 e⁻ ⇌ Zn
S
N
B
I
F_B
0 T
0.5 T
1.2 T
Pb
Cd
Current, µA
E, V vs. Ag/AgCl (3 M KCl)

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