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MICROCHIP CAPILLARY ELECTROPHORESIS WITH AMPEROMETRIC
DETECTION FOR METAL ION ANALYSIS

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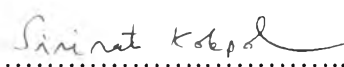
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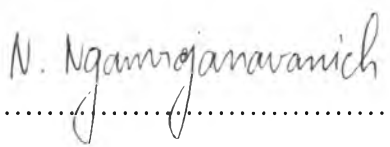
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งานวิจัยนี้เป็นการพัฒนาเพื่อการตรวจวิเคราะห์โลหะหนักหลายชนิดพร้อมกันและตรวจวิเคราะห์แบบรวดเร็วซึ่งได้แก่โลหะตะกั่ว, แคดเมียม, และทองแดง โดยใช้เทคนิคไมโครชิพอะปิลารีอิเล็กโทรฟอริซิสร่วมกับตัวตรวจวัดทางเคมีไฟฟ้า ระบบการตรวจวิเคราะห์โดยตรงแบบแอมเพอโรเมทรีในไมโครชิพอะปิลารีอิเล็กโทรฟอริซิสถูกนำมาใช้ในการตรวจวิเคราะห์ไอออนโลหะเหล่านี้ได้เป็นอย่างดี อิทธิพลจากศักย์ไฟฟ้าที่ให้กับระบบ, ศักย์ไฟฟ้าในการตรวจวัด, ความเข้มข้นและพีเอชของบัฟเฟอร์ที่ใช้ในการวิเคราะห์ต่อค่าการตอบสนองของตัวตรวจวัดซึ่งได้ทำการตรวจสอบและหาค่าที่ทำให้เกิดประสิทธิภาพการตรวจวัด จากผลการทดลองแสดงให้เห็นว่าการวิเคราะห์โดยใช้โซลันอิลิกโทรฟอริซิสในการแยกโลหะตะกั่ว แคดเมียม และทองแดงได้ในเวลาน้อยกว่า 3 นาที ใช้บัฟเฟอร์เอ็มเอเอส (MES) (พีเอช 7.0, 25 มิลลิโมลาร์) และแอลฮิสทีดีน (L-histidine), ให้ศักย์ไฟฟ้าในการแยก 1.2 กิโลโวลต์ และศักย์ไฟฟ้าในการตรวจวัดที่ -0.8 โวลต์ ค่าขีดจำกัดต่ำสุดของการตรวจวัดโลหะตะกั่ว, แคดเมียม, และทองแดงเป็น 1.74, 0.73, และ 0.13 ไมโครโมลาร์ (ค่าสัญญาณกระแสต่อสัญญาณรบกวนมีค่ามากกว่า 3) ค่าเบี่ยงเบนมาตรฐานสัมพัทธ์ของสัญญาณกระแสไม่เกิน 6 เปอร์เซ็นต์ และของเวลาในการเคลื่อนที่ของสารในชั้นแนลไม่เกิน 2 เปอร์เซ็นต์ ในงานวิจัยนี้ได้แสดงให้เห็นหลักการในการให้ศักย์ไฟฟ้ากับระบบไมโครชิพซีไอซึ่งสามารถนำไปใช้ได้ในอนาคต นอกจากนี้ยังแสดงให้เห็นการวิเคราะห์ไอออนโลหะในตัวอย่าง จากผลการวิเคราะห์ทำให้ได้ความมุ่งหมายว่าไมโครชิพซีไอร่วมกับตัวตรวจวัดทางเคมีไฟฟ้านี้จะเป็นอีกวิธีที่ใช้ในระบบการวิเคราะห์ระดับไมโครสำหรับตรวจวิเคราะห์อาหาร

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SARAWADEE KORSRISAKUL : MICROCHIP CAPILLARY ELECTROPHORESIS WITH AMPEROMETRIC DETECTION FOR METAL ION ANALYSIS. THESIS ADVISOR : ASSOC.PROF. ORAWON CHAILAPAKUL, Ph.D., THESIS COADVISOR : LUXSANA DUBAS, Ph.D., 127 pp.

This thesis demonstrates the fast and simultaneous detection of prominent heavy metals including lead, cadmium and copper using a microchip capillary electrophoresis with electrochemical detection. Direct amperometric detection mode for microchip capillary electrophoresis was successfully applied to analytes, the heavy metal ions. The influences of the separation voltage, detection potential, concentration and pH value of running buffer on the response of the detector were carefully investigated and optimized. The zone electrophoretic separation of lead, cadmium and copper is less than 3 min using a MES buffer and L-Histidine as background electrolyte (pH 7.0, 25 mM), employing 1.2 kV as the separation voltage and -0.8 V as the detection potential. The detection limits for Pb^{2+} , Cd^{2+} , and Cu^{2+} were 1.74, 0.73 and 0.13 μM (S/N = 3), respectively. The %RSD of peak current was < 6 % and the %RSD of migration times < 2% for prolong operation. To demonstrate the potential and future role of microchip CE, a new route in the real sample analysis was presented. The results obtained allow the proposed microchip capillary electrophoresis-Electrochemical detection as a real gateway to microanalysis in foods.

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ABBREVIATIONS AND SYMBOLS

i	-	current (A)
i_{pa}	-	anodic peak current (A)
i_{pc}	-	cathodic peak current (A)
E_p	-	peak potential (V)
E_{pa}	-	anodic peak potential (V)
E_{pc}	-	cathodic peak potential (V)
F	-	Faraday constant (96,484.6 C equiv ⁻¹)
A	-	area of electrode (cm ²)
D	-	diffusion coefficient (cm ² s ⁻¹)
ν	-	kinematic viscosity of the liquid (cm ² s ⁻¹)
υ	-	scan rate (V sec ⁻¹)
ω	-	angular velocity of the disk (radians per second)
C	-	solution concentration (mol dm ⁻³)
ppm	-	part per million
ppb	-	part per billion
mL	-	milliliter
μ L	-	microliter
g	-	gram
μ g	-	microgram
μ A	-	microamp
nA	-	nanoamp
μ m	-	micrometer
μ M	-	micromolar
nm	-	nanometer
i.d.	-	internal diameter
r^2	-	correlation coefficient
MES	-	2-Morpholinoethanesulfonic acid
L-his	-	(s)-2-Amino-3-(4-imidazolyl)propionic acid
V	-	volt