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Exploring New Frontiers with Capillary Electrophoresis

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Abstract

Capillary electrophoresis (CE) has emerged as a powerful analytical technique with wide-ranging applications in

control, protein analysis, DNA sequencing, environmental monitoring, food safety assessment, and forensic analysis,

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Introduction

Ca illa ele h e i (CE) ha eme ge a a e f l anal i al e hni e e l i ni ing he . el f e a a i n ien e in e i in e i n in he la e 20 h en . . e ing n a allele e i n, e ien , an e a ili , CE ha f n le ea a li a i n a a i main in l ing ha ma e i al, b i e hn l g , en i nmen al anal i , f ien e, an f en i ien e. e e hni e elie n he in i le f ele h e i , le e aging he i e en ial mig a i n f ha ge anal e n e he in en e f an ele i . el h gh a na a illa . lle i h a n i eb e. i n [1].

e a en f CE ma ke a igni an mile ne in e a a i n ien e, i ling e ea he i h a highl e ien a ble f e a a ing an an if ing m le mi e f anal e i h ema kable e l i n an en i i i . Unlike a i i nal h ma g a hi e hni e , CE e a e n a mi ale, all ing f a i anal i i h minimal am le n m i n an a e gene a i n [2]. i in he en minia i a i n n nl enhan e anal i al h gh b al fa ili a e in eg a i n i h he e i n me h , h a ma e me an e en e e , f he e an ing i anal i al a ili ie .

ne f he ke a an age f CE lie in i a ili e a a e anal e ba e n hei ha ge- i e a i , e ing ni e ele i i m lemen a he e a a i n e hni e . i a b e ha f ele i le ea a i n in he anal i f b i m le le in l ing ein , e le , n lei a i , an ab h a e , he e a i i nal h ma g a hi me h en fall h [3]. e e , CE enab le he e a a i n f enan i me an i i nal i me , ing in al ble in igh in he hi ali an a al i me i m f m n , hi h i e en ial in ha ma e i al e ea h an e el men .

Discussion

Ca illa ele h e i (CE) ha eme ge a a e f l anal i al e hni e i h le ea a li a i n a a i . el in l ing hemi , b i hemi , ha ma e i al, an en i nmen al ien e. a ili e a a e an anal e m le mi e i h high e ien an e l i n ha f elle n in e l a i n in ne f n ie . n

hi i i n [4], e ll el e in me f he e i ing e el men an en ial f e i e i n in a illa ele h e i .

Miniaturization and micro uidics: ne f he ke en in a illa ele h e i he ng ing minia i a i n f em , en in eg a e i h mi f i e hn l gie . inia i a i n e e al a an age in l ing e e am le an eagen n m i n, enhan e ili , an in ea e h gh . i f i CE la f m enab le a anal e , a ma i n, an in eg a i n i h e anal i al e hni e , a ing he a f in - f- a e iagn i , n- i e en i nmen al m ni ing, an high- h gh eening in g i e [5].

Enhanced separation techniques: A an emen in CE ha e le he el men f n el e a a i n e hni e aime a im ing e l i n, en i i i , an ele i i . Te hni e h a a illa i ele i f ing, a illa i a h h e i , an a illa ele h ma g a h ha e e an e he anal i al a ili ie f CE, all ing f he e a a i n f m le mi e i h n e en e e i i n [6]. A i i nall , he in eg a i n f CE i h ma e me (CE- S) ha enab le m ehen i e ha a e i a i n f b i m le le , me b li e , an ha ma e i al m n , ening ne a en e in e mi , me b l mi , an g me b li m ie .

High-throughput analysis and automation: A ma i n la a ial le in eamlining CE k , e ing anal i ime, an im ing e ili . Re en e el men in b i am le han ling, inje i n em , an a a e ing a e ha e enab le high- h gh anal i f am le , making CE an a a i e l f

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ine lb a e ing an in ial a li a i n [7]. F he m e, he in eg a i n f a i. ial in elligen e an ma hine lea ning alg i hm h m i e f eal- ime imi a i n f CE me h , a la i e n l f e a a i n n i n, an in elligen a a anal i , f he enhan ing he e ien an a a f CEb a e a a .

Multimodal and multidimensional CE: l im al an m l imen i nal CE a a he nb ine m l i le e a a i n e hni e e ie me h i hin a ingle la f m, e ing enhan e anal i al a bili ie f m le am le. B in eg a ing e hni e h a CE i h a illa ele he e i -ma e me (CE- S), CE i h la e-in e e en e e i n (CE- F), CE i h ele hemi al e e i n (CE-EC), e ea he an a hie e m ehen i e ha a e i a i n f anal e i h im e en i i , e i. i , an a al inf ma i n [8]. e e m l im al CE a egie n a li a i n in me b li e ling, e e gen mi , gl mi , an en i nmen al anal i , am ng he .

Emerging applications: Be an a i i nal anal i al hemi , a illa ele he e i i n ing n el a li a i n in eme ging a ea h a ingle- ell anal i , nan a i le ha a e i a i n, an b i en ing [9]. Single- ell CE enb le he anal i f in i i al ell i h high e l i n, e in ing in igh in ell la he e genei , b i ma ke e e i n, an g e n e. CEb a e b i en e a i, en i i e, an lb el-f ee e e i n f b i m le , a h gen , an en i nmen al an aminan , i h a li a i n in heal h a e, f d afe , an en i nmen al mi ni ing [10]. e e, CEb a e nan a i le anal i fa ili a e he ha a e i a i n f nan ma e ial f g eli e , iagn i , an nan i i g ie , n b ing he a an emen f nan e hn g -enb le a li a i n.

Conclusion

Ca illa ele he e i n in e h he b n la ie f anal i al ien e, e ing e a ile l i n f m le anal i al hallenge W i h ing ing inn a i n in minia i a i n, enhan e a a i n e hni e, a ma i n, m l im al a a he, an emeging a li a i n, CE i i e main a he f ef f anal i al hemi , i ing i e ie an a li a i n a e e. ef in he ea me.

References

A multicentre

The genus Shigella

Multi