INTRODUCTION

• A range of pathological conditions can lead to elevated blood ammonia and urea nitrogen levels
• These include kidney and liver dysfunction and urea cycle defects
• These conditions result in severe reduction in quality and quantity of life
• Blood nitrogen levels are controlled by dialysis and monitored using invasive blood tests
• Blood nitrogen levels have the potential to be monitored non-invasively in breath ammonia in breath [1]
• We have developed a device for monitoring human breath ammonia levels (Fig. 1)

DESCRIPTION OF THE SYSTEM

• Background ammonia levels in breath can be as low as a few ppb
• We have developed a disposable breath sampling user interface
• The disposable printed organic sensor for detection of ammonia is fabricated via the deposition of inkjet printing for the detection of hydrogen sulfide
• The change in conductivity can be measured using a range of electrochemical techniques
• Measurement in breath must deal with interference from temperature and humidity effects

THE PRINTED AMMONIA SENSOR

• The printed sensor is based on advanced nanomaterials and print fabrication technology (Fig. 2)
• Interdigitated electrodes are fabricated from screen-printed silver inks [2]
• The ammonia sensing layer is fabricated via the deposition of inkjet printed polyaniline nanoparticles [3]
• This combination makes the electrodes mass producible and highly reproducible with excellent sensitivity to ammonia down to low ppb levels
• Background ammonia levels in breath can be as low as a few ppb

PRINCIPLE OF OPERATION

• Exposure of the polyaniline to ammonia results in the de-doping of the semi-conducting emeraldine salt to the insulating emeraldine base (Fig. 3)
• The change in conductivity can be measured using a range of electrochemical techniques
• Measurement in breath must deal with interference from temperature and humidity effects

SYSTEM PERFORMANCE

• The human breath ammonia monitor is capable of detecting ammonia at background levels in human breath between 40 and 2,993 ppbv in simulated breath (Fig. 4)
• This covers the clinically important range necessary to monitor patients during haemodialysis
• Breath humidity and temperature do not result in significant interference

CONCLUSION

• Preliminary results show that this device has potential for detecting ammonia at background levels in human breath
• It is believed that the device will prove useful as a diagnostic device for assisting with haemodialysis, diagnosis of Helicobacter pylori, identification of halitosis, analysis of hepatic encephalopathy, evaluation of asthma, and other disorders associated with elevated breath ammonia levels

REFERENCES


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