Miniaturized solid-state ionophore-based microelectrode for ion transfer Voltammetry: stability problems

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Liquid based capillary microelectrodes have been well explored for ion transfer at the interface between two immiscible electrolyte solutions and many attempts to design ion-selective microelectrodes emerged based on it.[1] However, there has been a gap in producing durable and stable solid-state ion-selective microelectrodes for voltammetric ion sensing applications.[2] Some designs could be applied to a potentiometric readout, but a voltammetric control would be more attractive for numerous applications.[3] Here we show promising results with thin film K-selective microelectrode of 10 µm diameter interrogated by cyclic square wave voltammetry (CSWV). Using PEDOT-C14 as transducing layer and polyurethane as membrane matrix prevents the loss of ion sensing components. And the microelectrode can show a good Nernstian response. The logarithmic selectivity coefficients over sodium and calcium are found as -4.2 and -12.7 respectively, which meets the requirement for physiological measurements. Importantly, the difficulty of developing voltammetric thin film solid-state microelectrodes was found coincidently, as the water layer deteriorated the stability and reproducibility more seriously when the electrode dimensions were reduced to the micrometer scale. As a rougher transducer layer was electrodeposited on the gold surface, the performance of the microelectrode would deteriorate, as confirmed with AFM morphology studies. The results may be able to help researchers develop versatile applications in the future.

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[3] J. Zhai, Y. Zhang, D. Zhao, L. Kou, G. Zhao, *Anal. Chim. Acta* **2022**, 1191, 339209.