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Smartphone-Integrated Paper-based Fluorescence Optode for Point-of-Care Monitoring of Na^+/K^+ Ratio

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Abstract: The sodium-to-potassium (Na^+/K^+) ratio serves as an important biomarker with relevance to electrolyte balance, renal health, hypertension, and metabolic and inflammatory conditions. Non-invasive body fluids offer practical routes for assessing the Na^+/K^+ ratio in point-of-care applications. Traditional methods for measuring Na^+ and K^+ such as flame photometry, ion-selective electrodes, and ICP-based techniques, are costly and confined to laboratory settings, making them unsuitable for rapid and point-of-care testing. We present a portable, low-cost, smartphone-integrated paper-based ion-selective fluorescence optode for quantitative detection of the Na^+/K^+ ratio. The sensing platform utilizes BODIPY-based fluorescent paper strips with two spatially separated sensing zones exhibiting high selectivity for Na^+ and K^+ . Fluorescence emissions from the two zones is recorded by a smartphone using a customized 3D-printed optical assembly. Preliminary observations demonstrate the sensing system's high specificity for Na^+ and K^+ with rapid detection, providing an accessible, user-friendly platform for clinical monitoring.

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