Miniaturized cell for spectroelectrochemistry at the liquid-liquid interface

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Ion-transfer voltammetry at the interface between two immiscible electrolyte solutions (ITIES) offers an alternative approach to studying interactions between ionophores and ions. It can yield more straightforward data compared to ion-selective electrodes, which often have their sensitivity and selectivity influenced by factors such as the type of plasticizer, lipophilic salt, and the component ratios in the membrane. However, standard ITIES configurations are typically custom-built or demand specialized apparatus.

In this study, we developed a miniaturized version of a conventional electrochemical cell featuring a macro-scale liquid/liquid interface (see Fig. 1). Unlike traditional setups that require 5–15 mL of each phase, our design uses only 150–200 µL. Thanks to the large interface and symmetrical diffusion, this compact system enables straightforward data interpretation and direct comparison with previously published results. It retains the benefits of a standard electrochemical cell while avoiding the limitations associated with micro-ITIES. The device is assembled using commonly available lab items, such as a glass spectrophotometric cuvette and a Pasteur pipette. Like the standard cell, it is transparent, making it possible to observe unusual phenomena at the interface—such as deposit formation, bubble generation, or micro-emulsions. The system setup fits within a cuvette, making it suitable for spectroelectrochemical experiments, which increases the possibility of conducting research other than electrochemical.

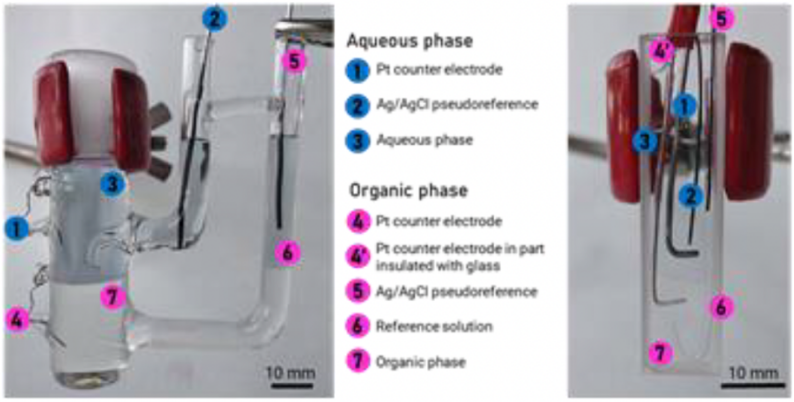

Figure 1: A photograph showing the standard cell (on the left) and the miniaturized cell (on the right) for electrochemistry at the liquid-liquid interface. In the miniaturized version, the counter electrode from the organic phase extends through the aqueous phase, requiring glass insulation. All other components of the cell are consistent with the design of the standard, larger cel.

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References

[1] Durka M, Durka K, Luliński S, Witkowska Nery E. Screening of organoboron compounds as potential ionophores in a miniaturized ITIES cell. ChemRxiv. 2024; doi:10.26434/chemrxiv-2024-jncnf