Electrochemical control of crystallization at soft interfaces

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Crystallisation processes are some of the most important biological processes that occur in living organisms. These can be both beneficial (formation of skeletons and protective shells etc.) and undesirable (kidney stones, gout etc.). Many of these processes occur at soft interfaces (cell membranes and the like).

In this work, we have used the interface between two immiscible electrolyte solutions (ITIES) to investigate crystallization under electrochemical control at soft interfaces. While various chemical strategies are well known in terms of controlling and mitigating unwanted crystallization processes, non-redox electrochemical control is not so well known. In this work, barium sulfate is used as a model compound as proof of the principle that crystallization can be controlled electrochemically. Initial experiments were undertaken at open-circuit conditions (i.e. without electrochemical control). Barium or sulfate ions were placed in the organic phase and their spontaneous transfer to the contacting aqueous phase monitored (see Figure 1). This was then extended by the addition of ionophore to the organic phase to test the possibility of inhibiting the crystallization (Figure 1b). Finally, the control of crystallization via application of a given potential was investigated.

Figure 1. (a), SEM image shows barium sulfate precipitated in absence of ionophore and (b), SEM shows no precipitation in presence of calcium ionophore based on C. Figure based on [1]

Application of potentials which favoured barium remaining in the organic phase resulted in no crystallization. Applied potentials which favoured transfer of barium ions to the aqueous phase resulted in crystallization. As a result, the applied electrochemical potential is a viable means of controlling ion transfer and, therefore, supersaturation and crystallization. This opens up the possibility of investigating processes that occur at soft interfaces with greater control and ultimately greater understanding.

References

[1] *CrystEngComm*, 2022,24, 7793, DOI 10.1039/D2CE01102F.