Oxidizing foams

Cecile Monteux [1]

Pierre Trinh [1]

Patrick Perrin [1]

Nadège Pantoustier [1]

Grégory Lefèvre [2]

[1] CNRS/ESPCI, Paris

[2] CNRS/IRCP, Paris

E-mail: cecile.monteux@espci.fr

ABSTRACT

Foams, which contain a lot of interfaces are promising media to perform chemical reactions. In the context of electronic wastes recycling, where huge volumes of oxidizing aqueous solutions are used to leach metals, using foams would have the advantage to reduce the amount of water to be treated after the leaching process. To establish the proof of concept that foams can be used as a leaching medium for metals, we study a first simple chemical reaction occurring in a foam, the oxidation of copper, Cu, by dioxygen, O_2, in the presence of H^+.

$$2Cu + O_2 + 4H^+ \rightarrow 2Cu^{2+} + 2H_2O$$

In this system, O_2 is brought by the air bubbles, while the continuous phase contains the H^+ ions at various concentrations. We find that these foams enable to dissolve Cu than a standard H^+ solution thanks to the enhanced transport of oxygen through the foams.

To study the coupling between the reaction kinetics and H^+/O_2 transport through the foams by drainage/ripening respectively, we perform model forced drainage experiments, where we impose a controlled flow rate of H+ solution through the foam. We find that the quantity of dissolved copper presents a maximum with the flow rate. At low flow rates, the quantity of Cu^{2+} produced by the reaction increases with the flow rate, because the amount of H^+ increases. At higher flow rate, however, the transport of O_2 becomes slower due to the fact that the liquid fraction and film thickness increases with the flow rate, hence the quantity of Cu^{2+} ions produced decreases with the flow rate. Our results show that foams are promising materials for the leaching of metals and that the structure of the foams controls the transport of the reactants hence the leaching reaction.