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Towards a fine knowledge of kinetics mass transfer, contribution of the microfluidics device

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During reactive liquid-liquid extraction, mass transfer is commonly considered as controlled either by the kinetics of the chemical reaction solvation at the interface or by the diffusion of the solute through the two boundary layers. A fine knowledge of the latter is one of the keys to develop a full phenomenological model of a new liquid-liquid extraction process. Usually kinetics studies enable only to reach an overall (global) kinetic rate constant that includes at last the both phenomena. The present paper discuss on the various methods allowing the discrimination between diffusion and chemical kinetics when studying uranium(VI) extraction from a nitric aqueous stream by a monoamide solvent.

In the case of the extraction of U(VI) in HNO₃ by monoamides, a cross comparison of results obtained with complementary techniques as single drop, Nitsch cell and rotating membrane cell allowed to estimate the contribution of the chemical mass transfer [1]. To go further, the microfluidics technology was chosen as an interesting way to study such kinetics: it offers a well-controlled interfacial area, a significant decrease of contact times and a reduction of the molecular diffusion length [2]. Then, an original experimental setup using high velocities into a microfluidics chip to reduce dramatically the diffusion contribution on mass transfer kinetics has been developed [3].

Mass transfer studies on monoamide based extraction systems have also been achieved with microsystems chips. Determining the overall global mass transfer coefficient from these experiments according to the two films theory, the comparison of the results with the single drops ones suggests an increase of the mass transfer regime at the micro scale.

Regarding to the increase of uranium(VI) transfer kinetics within the microfluidics technology, we assume that the diffusion phenomenon is minimized and that the experimental setup developed allows an approach of the chemical transfer contribution.

[1] R. Berlemont, Kinetics extraction of uranium(VI) and plutonium(IV) using N,N-dialkylamides, PhD thesis **2015**, Paris VI, ffNNT : 2015PA066320ff. fftel-01884170

[2] N. Di Miceli Raimondi et al. Chem. Eng. Sci. **2014** 105 :169–178, doi:10.1016/j.ces.2013.11.009

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