

Liquid – liquid – extraction with the MicroSISAK – system

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For studies of the chemical properties of the heaviest elements ($Z > 103$), it is indispensable to use fast and efficient systems, because of their short half-lives and low production rates [1]. An established possibility for liquid chemistry in this field is the liquid – liquid – extraction, like it is used in the SISAK – system [2]. The *Institut für Mikrotechnik Mainz* (IMM) developed a device that agitates two liquids via a static digital mixer and separates them again via a hydrophobic Teflon membrane by using micro reaction technology [3]. It is called **MicroSISAK** and consists of micromechanical discs made of titanium with an inner volume in the μl – range. Previous experiments have shown that the principal idea could be realised with this apparatus. Complete phase separation is achieved by setting a backpressure at the outlet of the aqueous phase of the device [4].

In a series of experiments we studied the influence of the temperature on the extraction yield in the MicroSISAK – apparatus. For this we chose the extraction system Hf in H_2SO_4 vs. TOA in toluene. Temperature control is achieved via an electric heating element in a copper strip around the microreactor. As expected, the extraction yield rises with increasing temperature for different flow rates or concentrations of TOA and H_2SO_4 respectively (figure 1). The extraction yield was determined using Hf-181 as a radioactive tracer.

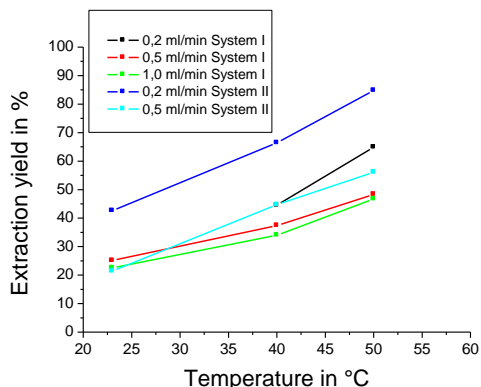


Figure 1. Extraction yield in the MicroSISAK – apparatus depending on the temperature for different flow rates and concentrations. System I: 1,0 mol/l TOA in toluene vs. 0,5 mol/l H_2SO_4 . system II: 0,1 mol/l TOA in toluene vs. 0,1 mol/l H_2SO_4 .

Another possibility to get higher extraction yields is to extend the contact time of the two phases. If the flow rates shall not be changed, one has to increase the volume between the mixer and the separation unit. Therefore the *IMM* designed a new disc with meandering flow scheme, to integrate into the MicroSISAK stack system (figure 2). Now extraction experiments were made for different flow rates of the system H_2SO_4 (0,1 mol/l) with Hf-181 (10^{-6} mol/l) vs. TOA in toluene (0,1 mol/l).

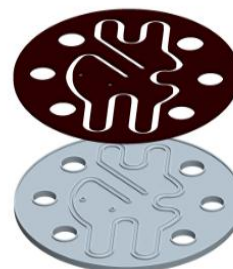


Figure 2. Scheme of the new disc (grey) for the MicroSISAK to increase the contact volume, with a seal (black)

Here also the extraction yield rises as it was expected from 25-40 % without the new disc (see [5]) to now 60-80 % with it (see figure 3).

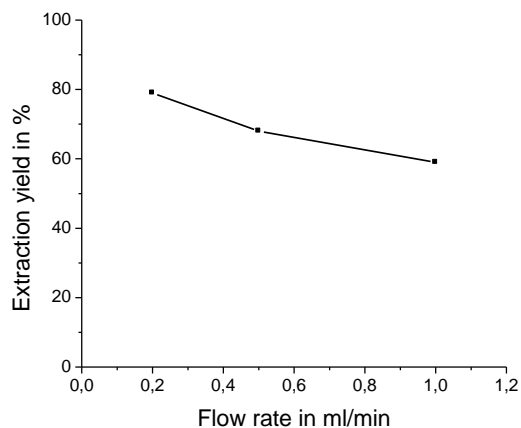


Figure 3. Extraction yield depending on the flow rate for the modified MicroSISAK - apparatus

Similar experiments - larger contact volume and higher temperature - were also made with the system Tc-99m (carrier-free) in nitric acid (0,01 mol/l) vs. TPAC in chloroform (10^{-4} mol/l) and evidenced the same results: higher extraction yield than in earlier experiments [5].

In the near future, on-line experiments with fission products are planned at the research reactor TRIGA Mainz.

References

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