

PEG/金属(II)イオン系水性二相系混合溶液を用いたマイクロチャネル内における TRDF の創出と分析化学的応用

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TRDF creation in microchannel using PEG/Metal(II) ion aqueous two-phase mixed solution and Its application to analytical chemistry (¹Doshisha University, Faculty of Science and Engineering) ○Daiki Ishikawa,¹Yusei Onaka,¹Kazuhiko Tsukagoshi¹

We have been studying the specific fluid behavior of aqueous two-phase mixed solution pumped into microchannels under laminar flow conditions. The aqueous two-phase mixture changes from homogeneous one-phase to heterogeneous two-phase depending on the temperature. When an aqueous two-phase mixed solution is pumped into a microchannels and the temperature is changed, a phase-separated multiphase flow with a liquid-liquid interface is generated. The phase separated multiphase flow has various states such as droplet, slug, parallel, and annular flow, among which the annular flow is called Tube Radial Distribution Flow (TRDF) and has been used for analysis. In this study, for the first time, TRDFs of polyethylene glycol (PEG)/metal (II) ionic aqueous two-phase mixed solution were created and applied to analytical chemistry.

In fact, we dissolved metal ions of copper(II), manganese(II), and cobalt(II) and PEG in water at 50°C, and confirmed that the solution became an aqueous two-phase mixed solution when copper(II) and manganese(II) were used. We focused on the aqueous two-phase mixed solution of PEG and copper(II) ion, and pumped it into the microchannel. We focused on the aqueous two-phase mixed solution of PEG and copper(II) ion and pumped it into the microchannel. TRDF was mainly expressed at a flow rate of 5~10 µl/min. When this solution was made alkaline and HSA was added, the biuret reaction was observed.

Keywords: Aqueous two-phase system, Tube Radial Distribution Flow, Micro Channel, Phase-separation multiphase flow

我々はマイクロチャネルなどの微小空間に、水性二相系混合溶液を層流条件下で送液することにより発現する特異的流体挙動について研究している。水性二相系混合溶液は温度によって均一相から不均一二相に変化する。水性二相系混合溶液を微小空間へ送液し、温度を変化させると、液-液界面を有する相分離混相流が生じる。相分離混相流は液滴流、スラグ流、並行流、環状流という様々な状態があるが、その中の環状流を管径方向分配流 (Tube Radial Distribution Flow; TRDF) と呼び、これを分析に利用してきた。本研究では初めて polyethylene glycol(PEG)/金属(II)イオン系水性二相系混合溶液の TRDF の創出および分析化学的応用の検討を行った。

実際に、銅(II)、マンガン(II)、コバルト(II)のそれぞれの金属イオンと PEG を水に溶解し、50°Cにしたところ、銅(II)とマンガン(II)を用いた場合に水性二相系混合溶液となることを確認した。PEG と銅(II)の水性二相系混合溶液に着目し、マイクロチャネルに送液した。TRDF は主に流速 5~10µl/min で発現した。この溶液に人血清アルブミンを加えるとビウレット反応が起こることを確認し、TRDF への影響を調べた。