第 177 回講演会

研究講演会：水処理のための膜技術

International Workshop on membranes for water treatment

主催：膜工学分科会，中国地区化学工学懇話会

2011 年 6 月 18 日(土)に，イスラエルから，Slava Freger 教授および Moshe Herzberg 教授が広島大学を訪問します。この機会にあわせて，膜による水処理に関する国際ワークショップを開催します。

20 世紀は石油の世紀，21 世紀は水の世紀」とよばれるように，エネルギー・環境問題とともに，水問題の解決は 21 世紀の重要課題となっています。中でも膜分離法は，浄水および排水処理などの水処理プロセスにおいて，必要不可欠な単位操作となっています。本ワークショップでは，膜を用いた水処理の最新研究・開発動向について，Slava Freger 教授からポリアミド逆浸透膜の製膜メカニズムとそのシミュレーション，Moshe Herzberg 教授には水処理膜へのバイオファウリングについて講演いただきます。

日　時：2011 年 6 月 18 日(土)10:00～12:15

場　所：広島大学工学部(112 号講義室)

交　通：山陽本線西条駅下車、バス 15 分、大学会館前下車

山陽新幹線東広島駅下車、タクシー10 分

広島バスセンターから直行バス約1時間、大学会館前下車

講演プログラム

10:00-10:45

Prof. Slava Freger (Ben-Gurion University of the Negev)

Understanding how desalination membranes work

10:45-11:30

Prof. Moshe Herzberg (Ben-Gurion University of the Negev)

Biofouling mitigation of UF membranes in MBR using graft-polymerization: Measurements, mechanisms, and monitoring

11:30-12:15

（交渉中）

High-Performance 逆浸透膜の開発と応用

参加費：無料

申込先：

金指正言
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講演要旨

Prof. Viatcheslav (Slava) Freger
Zuckerberg Institute for Water Research and
Department of Biotechnology and Environmental Engineering
Ben-Gurion University

Understanding how desalination membranes work

Polyamide composite membranes are the workhorse of the modern desalination by reverse osmosis (RO) and other emerging technologies. Despite their wide use and decades of research since their empirical discovery, quantitative understanding of their transport properties and selectivity is still a challenge, greatly complicated by the thinness, complex morphology and compositional non-uniformity of the polyamide layer. In this talk I will present and discuss the theoretical and experimental approaches that we and others have used for gaining insights into the mechanisms of exclusion and transport for salts and organic molecules in the dense selective layer. These results emphasize the key role of thermodynamic factors in the membrane selectivity in RO and similar processes and importance of adequate thermodynamic modeling. I will also present examples of how this understanding may be used for improving membrane performance through membrane modification.

Biofouling mitigation of UF membranes in MBR using graft-polymerization: Measurements, mechanisms, and monitoring

Moshe Herzberg
Zuckerberg Institute for Water Research, Ben Gurion University of the Negev, Sede Boqer Campus, Midreshet Ben Gurion, 84990, Israel.

Optimizing ultrafiltration (UF) membranes modification processes to achieve highest permeability on one hand and reduce organic- and bio-biofouling on the other, are parts of a critical piece in design of membrane bioreactor (MBR) systems. In this study, a polyvinylidene fluoride (PVDF) membrane (ZW-10, GE) as well as PVDF surfaces were used as substratum for antifouling coating to study the fouling resistance properties of the grafted layer as well as optimizing the UF membrane permeability. Graft polymerization was performed using the negatively-charged 3-sulphopropyl methacrylate (SPM) and positively charged [2-(Methacryloyloxy)ethyl]-trimethylammonium (MOETMA) monomers to yield a copolymer layer on the membrane surface. Using quartz crystal microbalance with dissipation monitoring (QCM-D) technology, we evaluated the extent of the graft polymerization by monitoring the increased mass on PVDF coating of the QCM-D sensor. Changes in the QCM-D frequency and dissipation shifts were used to evaluate the grafted layer conformation and swelling properties at different aquatic conditions. For analysis of the reduced biofouling due to graft-polymerization, the adsorption of extracellular polymeric substances (EPS) extracted from a municipal wastewater MBR to the modified and non-modified surfaces was analyzed in the QCM-D flowcell. In addition, single fiber UF membranes originated from ZW-10 UF module were modified in a similar graft-polymerization technique. These experiments were conducted with aim of minimizing possible decrease in membrane permeability as well as for monitoring the modified membrane reduced biofouling properties in the municipal wastewater MBR unit. A significant decrease in EPS adsorption to the modified PVDF coated sensor in the QCM-D flowcell was observed in the presence of simulative MBR feed solution. According to the frequency changes analyzed by the QCM-D, the modified PVDF sensor showed ~70% reduction in EPS adsorption compared to the non-modified one. Implementing this specific graft-polymerization, we also show that salt solution is required to swell this modified layer in order to make it function as strong anti-fouling surface. Interestingly, improvement in fouling resistance was dramatic in NaCl solution, and was not observed in double distilled water (DDW). In DDW, the strong intra-molecular association makes the polymer less hydrated and swelling is very low. A redox-initiators graft-polymerization of the membrane fiber surface was applied during injection of the monomers and the initiators solutions to the membrane fiber under different flow conditions. Current study is being conducted for analyzing the reduced organic- and bio-fouling by the grafted layer in a real MBR system treating municipal wastewater.