九州大学　博士課程教育リーディングプログラム
グリーンアジア国際戦略プログラム
Kyushu University Program for Leading Graduate Schools
Advanced Graduate Program in Global Strategy for **Green Asia**

2013 年 7 月 12 日

GA コース生および GA-RA 登録学生各位

グリーンアジアレクチャーシリーズ「グリーンアジアのためのマテリアルイノベーション」および集中講義のご案内

このたび当プログラムでは、資源・材料分野の海外著名研究者を招聘し、標記のレクチャーシリーズおよび集中講義を開催します。これらすべてを受講したコース生には、「地球資源システム工学特別講義 I」の単位が認定されます。新炭素資源学コースに所属し、GA-RA 登録学生には、GA レクチャーシリーズの部分が新炭素資源学コースの「フォーラム」の一部となります。
講義だけではなく、博士を目指したご自身の体験を交えたお話が伺える貴重な機会になると思いますので、ぜひご参加ください。出席を希望する学生は、8 月 10 日までに三木助教（miki@mine.kyushu-u.ac.jp） までご連絡ください。

●グリーンアジアレクチャーシリーズ「グリーンアジアのためのマテリアルイノベーション」
2013 年 9 月 9 日(月)　13:00-17:00
九州大学伊都地区　ウエスト 2 号館 5 階 517 室

13:00-13:10　Introduction
Keiko Sasaki (Professor, Kyushu University)
13:10-14:10　All Wet or Not: Explorations in Aqueous Processing Systems
Kwadwo Osseo-Asare (Distinguished Professor, Pennsylvania State University)
14:10-15：10　Flotation Chemistry
Anh Nguyen (Professor, University of Queensland)

15:10-15:30　Break
15:30-16:30　Prospects for Energy Minimization in the Electrowinning of Base Metals
Michael Nicol (Professor, Murdoch University)
16:30-17:00　Free discussion

講演の概要は別項

2013 年 9 月 10 日(火)　10:30-12:00, 13:00-14:30
九州大学伊都キャンパス　ウエスト 2 号館 5 階 517 室

Prof. Anh Nguyen

<u>September 10th (Tue) 10:30-12:00, 13:00-14:30</u>
<u>Physics and Engineering of Flotation,</u>

Anh Nguyen (Professor, University of Queensland)

In addition to flotation chemistry, flotation separation also requires a good understanding of many other physical and engineering aspects, such as the production of fine air bubbles, optimal mixing in flotation cells, and flotation kinetics. This lecture will cover the following topics: dynamics of bubbles and particles in a flotation cell, bubble-particle interactions, first-principle modeling of flotation kinetics, froth drainage, residence time, perfect-mixing and plug-flow operations, unit cells, flotation banks, equipment for laboratory testing, flotation columns and new types of flotation cells, effect of particle size on flotation, size-by-size analysis, entrainment, flotation of fine and coarse particles, selectivity and particle size effect, and mass balances and reconciliations for separation nodes and overall circuits. By attending this lecture, the participants will gain the basic chemical and physical principles of flotation, and its industrial practice and applications. They will be able to extend greatly their understanding of the flotation process and appreciate the complexity of industrial flotation processes, and the technical challenges and skills necessary for designing and operating flotation plants in the industry.

“Flotation Chemistry”

Anh Nguyen (Professor, University of Queensland)

Flotation is a separation process by attaching hydrophobic (water-repelling) particles to air bubbles which rise to the surface and overflows the weir of the cell to the concentrate launder. Hydrophilic (water-attracting) particles do not attach to air bubbles and remain in the cell to be discharged through the bottom of the cell. Flotation has been the workhorse of the mineral industry for more than 100 years and has been expanding into many other areas, including flotation deinking of wastepaper for recycling, soil remediation and water treatment. This lecture will focus on chemical aspects of flotation. Specifically, it will cover the surface chemistry and solution of flotation, the chemicals used in flotation and many examples of flotation of sulfide and non-sulfide minerals. The relevant topics of flotation surface chemistry and solution chemistry will include hydrophobicity/contact angle, induction time, surface forces, and Eh-pH dependence and control. The flotation chemicals will include many surfactants used to control the solid surfaces (the collectors), the air-water interface (frothers) and many other organic and inorganic chemicals for activating and depressing the mineral floatability. Examples of flotation application will include flotation sulfides of base metals, flotation insoluble and semi-soluble minerals and silicates, and flotation of soluble minerals such as sylvite (KCl) important for the production of fertilizers.

2013 年 9 月 11 日(水)　 10:30-12:00, 13:00-14:30
九州大学伊都キャンパス　ウエスト 2 号館 5 階 517 室

September 11th (Wed) 10:30-12:00, 13:00-14:30
The Partial Charge Model: Electronic Structure, Hydrolysis, and Metal Complexation in Aqueous Solution

Kwadwo Osseo-Asare (Distinguished Professor, Pennsylvania State University)


Prof. Osseo-Asare

According to the concept of electronegativity equalization, the shared electrons in a stable molecule are distributed among the constituent atoms in such a manner that the electronegativity (χi) of each bonded atom attains the same magnitude as the mean electronegativity of the complex (χ).　This electronegativity equalization results in the acquisition of partial charges (δ_i) by the constituent atoms.　For a complex with total charge z, the partial charges on the constituent atoms satisfy the condition:

$$z = \sum_i p_i \delta_i$$

where pi is the number of moles of atom i in one mole of the complex.　The partial charge distribution in a molecule provides a powerful predictive tool for the aqueous chemistry of metal cations. The following topics will be covered in this class:

- Ionization energy & electron affinity
- Lewis structures & bond polarity
- Electronegativity of an atom
- Partial charge of a bonded atom
- Mean electronegativity of a molecule
- Partial charge distribution in a molecule
- Mean electronegativity of aqueous solutions
- Partial charge model: Hydrolysis of metal cations; pH-dependent speciation

Partial charge model: Polymerization, precipitation (oxide vs hydroxide), and metal complexation

“All Wet or Not: Explorations in Aqueous Processing Systems”
Kwadwo Osseo-Asare (Distinguished Professor, Pennsylvania State University)

The presentation begins with a brief introduction to the speaker’s educational background, including experiences in a developing country (Ghana), and University of California, Berkeley (USA). Next follows an outline of the speaker’s teaching, learning, and research philosophy and tools, with a focus on the *common denominators* in aqueous processing: from *unit operations* to *principles of action (physicochemical phenomena)* and a selected *set of scientific & engineering tools*: *thermodynamic modeling*, *electrochemical science and engineering*, plus *interfacial and colloidal phenomena*. Aqueous processing systems are inherently heterogeneous in nature. Particles, drops, bubbles, films, and bulk phases encounter each other at interfaces. The ability of a reactant or surface-active species to congregate at the interfacial region can, therefore, have crucial consequences on reaction rates, product yields, and product characteristics. Yet initial efforts by this speaker to secure funding for research into the interfacial aspects of solvent extraction were met with strong skepticism from reviewers. The challenges presented by this reaction of the research community are discussed. The critical roles played by the interfacial region and by interfacially active species in materials processing and separations systems are then illustrated by considering how: (a) colloids and surfaces contribute to synergistic metal extraction and enhanced kinetics in liquid-liquid extraction, (b) aqueous biphase systems obtained in certain polymer-, surfactant-, and inorganic ion-containing solutions may be utilized to effect liquid-liquid separation of colloidal particles, (c) interfacial and semiconductor electrochemistry can drive important physicochemical processes in electroplating, electronic materials processing (chemical-mechanical polishing, CMP) and hydrometallurgical leaching systems, and (d) the evolution of silica (SiO_2) nanoparticles in microemulsion-mediated synthesis is affected by surfactant properties and materials synthesis protocols. An ongoing attempt to translate the speaker’s teaching and learning philosophy into a textbook project on aqueous processing is described. The Green Asia class to be led by this speaker will be based on draft chapters from this book project.

2013 年 9 月 12 日(木)　 10:30-12:00, 13:00-14:30
九州大学伊都キャンパス　ウエスト 2 号館 5 階 517 室

<u>September 12th (Thu) 10:30-12:00, 13:00-14:30</u>
<u>The Mixed Potential Model for Leaching-Application to the Dissolution of Oxide and Sulfide Minerals</u>
Michael Nicol (Emeritus Professor, Murdoch University)


Prof. Michael Nicol

The electrochemical principles that underlie the mixed potential model for the corrosion of metals will be described. The application of the model to the dissolution of selected oxide and sulfide minerals will be developed qualitatively and the extension to a quantitative model will be described. Examples that will be covered include oxide minerals such as uranium dioxide, manganese dioxide and sulfide minerals such as pyrite, sphalerite and copper sulfides. The limitations of the model as applied to the dissolution of chalcopyrite, pyrrohtite and sphalerite will also be dealt with in terms of non-oxidative processes.

"Prospects for Energy Minimization in the Electrowinning of Base Metals"
Michael Nicol (Emeritus Professor, Murdoch University)

Electrical energy represents a significant proportion of the operating costs of businesses involved in base metals electrowinning. Cost pressures are likely to rise from a combination of power supply shortages, such as have already occurred or were threatened in some regions of the world, and the large carbon footprint of an electrowinning operation. In the more extreme situation of reduced power availability, production may also be affected. This presentation will focus on developments aimed at reduction of the specific electrical energy consumption in large electrowinning operations such as those in the copper and zinc industries. Areas to be discussed include the development of novel anodes, reduction in energy losses by on-line monitoring of cell performance and improvements in current efficiency.