# Report on the 16th International Conference on Flow Injection Analysis (ICFIA 2010) Including Related Techniques, in Collaboration with the Japanese Association for Flow Injection Analysis (JAFIA), held in Pattaya, Thailand, April 25-30, 2010

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## 1. Introduction

The joint meeting of ICFIA and JAFIA was held at the Garden Sea View Resort Hotel. It was hosted and organized by Duangjai Nacapricha, Mahidol University, Orawon Chailapakul, Chulalongkorn University, and Jaroon Jakmunee and Kate Grudpan, Chiang Mai University. It was also held jointly with the 2nd International Mini-Symposium on High Throughput Screening (2nd IMS-HTS). There were a record number of 189 participants from twenty countries, including 25 JAFIA members, and 8 accompanying persons. Also, the newly established Thai Association for Flow-based Analysis (Thai-AFA) contributed to this meeting. The meeting indicated the friendly collaborations among multi-nations as well as multi-generations.


## 2. Social events

An opening ceremony and welcome party was held Sunday evening, with cocktails at the swimming pool, and a chance for regular and new attendees to meet. A typical Thai barbeque was enjoyed Tuesday evening at the Aroy Jang BBQ restaurant, where diners cook their own food on a grill-pot. We were transported to the restaurant in Song Thaew vehicles, modified open-air pickup trucks used by local people.

Wednesday was a traditional day for excursions. During the day, we visited the Nongnooch Tropical Botany Garden, which included entertainment by colorful Thai dancers and an elephant show. Then to the Suphattra Land farm where we were treated to samples of Thai fruit. In the evening was the famous Tiffany show in Pattaya, followed by a stroll along the "Walking Street".

The conference banquet and party was Thursday evening, featuring Thai performances and music with local instruments, and game entertainment by participants.


## 3. Scientific program

The program included 44 oral presentations and a record number 145 poster presentations, held Monday, Tuesday, Thursday, and Friday. The oral presentations were chaired by Kate Grudpan, Norio Teshima, Chatchalida Boonpaniad, Mitsuko Oshima, Tadao Sakai, Adisorn Tuantranont, José Costa Lima, Somchai Lapanantnoppakhun, Toshihiko Imato, António Rangel, Spas Kolev, Aristidis Anthemidis, Petr Solich, Illdikó Tóth, Victor Cerdà, Atitaya Siripinyanond, Shoji Motomizu, Napaporn Youngvises, Massaaki Tabata, Orawon Chailapakul, Rasamee Chaisuksant, Koichi Oguma, Tsutomu Nakaoga and Yasuhiro Iida.


The program began Monday morning with an invited opening lecture by Gary Christian (University of Washington, USA) who traced the evolution of flow injection analysis and related conferences, and ended with an invited closing lecture on Friday by Victor Cerdà (University of the Balearic Islands, Spain) discussing current and future projects in flow analysis from his laboratory, emphasizing instrumentation and various applications, including selenium speciation, low levels of uranium determination using long flow detection cells, and organic compound determinations using multisyringe chromatography.

Kate Grudpan and Ian McKelvie solicited remembrances from pioneers and other prominent members of the FIA community of what interested them in FIA and their views of historical developments and some of their key contributions, and assembled them into a PowerPoint slideshow presentation, which Kate gave at the opening, along with music. One can download this unique and historical presentation from the ICFIA 2010 website www.science.cmu.ac.th/icfia2010 by clicking on "downloads fiabio part 1-4" which appears on the left bottom of the main page (recommend without music for faster download). Contributors, with historical pictures, include Gary Christian, Alan Townshend, Jarda Ruzicka, Elo Hansen, Bo Karlberg, Lola Luque de Castro, Tadao Sakai, Shoji Motomizu, Jacobus (Koos) van Staden, Elias A. G. Zagatto, Paul Worsfold, Purnendu (Sandy) Dasgupta, Victor Cerdà, José Luis F. Costa Lima, Jose Martinez Calatayud, Manuel Miro, Jose Luis Burguera, Boaventrua F. Reis, Peter Solich, Miroslav Polášek, Spas Kolev, Marek Trajanowicz, Ian McKelvie, and Kate Grudpan.

**Instrumentation/detection.** *Kata Jaruwongrungsee* (National Electronics and Computer Technology Center, Thailand) described a quartz crystal microbalance based sensor array for FIA. *Paula Fortes* (University of São Paulo, Piracicaba, Brazil) applied quantum dots nanocrystals as luminescent sensitizers in flow systems. *Shoji Motomizu* (Okayama University, Japan) described a computer-controlled chemical analysis system for sample pretreatment and multi-species, composed of Auto-Pret with a mini-column and spectroscopic detector. *Wasin Wongwilai* (Chiang Mai University, Thailand) exploited modern information technology devices as detection units for flow based chemical analysis, including a webcam camera, and a flatbed scanner for microtiter well plates, as well as the ability to control a system remotely via the web.

**Separations, preconcentration, reactors, reagents.** *Tranh Duc Mai* (Hanoi University of Science, Vietnam) used capillary electrophoresis with a contactless conductivity detector for simultaneous determinations in sequential injection analysis (SIA). *Kunio Kawamura* (Osaka Prefecture University, Japan) used a hydrothermal reactor system for FIA of trace metals, achieving reactions in 40 msec in a fused silica capillary. *Spas Kolev* (University of Melbourne, Australia) described on-line separation in FIA, using polymer inclusion membranes for the determination of Zn(II) in complex aqueous media. *Rodjana Burakham* (Khon Kaen University, Thailand) used sequential injection lab-on-valve (LOV) with HPLC for on-line renewable solid phase extraction of carbamates. *Aristidis Anthemidis* (Aristotle University, Greece) described an integrated membraneless sequential injection LOV gas liquid platform incorporating an Oasis® HLB microcolumn for cold vapor AFS determination of mercury. *Koichi Oguma* (Chiba University, Japan) determined uranium in seawater spectrophotometrically with on-line preconcentration. The uranium was concentrated 20-fold on an amidoxime immobilized resin at pH 5.5 and eluted with 0.01M HCl, with a detection limit of 0.13 ng/mL. Calcium and magnesium interference was masked with CyDTA. *António Rangel* (Universidade Católica Portuguesa, Portugal) exploited the bead injection LOV approach for the spectrophotometric determination of iron in wine. *Abubakr Idris* (King Faisal University, Saudi Arabia) described experimental guidelines for developing sequential injection chromatography methodologies. Multi-response, including peak shape, peak height, separation, background, repeatability, retention time and overall analysis time, was considered. Conditions examined included sample volume, conditioning volume and tube lengths connecting various devices, besides flow rate for conditioning column and separation. *Atitaya Siripinyanond* (Mahidol University, Thailand) described field flow fractionation as an efficient approach for matrix removal and analyte preconcentration for ICP spectrometry. *Patcharin Chaisuwan* (Srinakharinwirot University, Thailand) reported on the use of monolithic materials for micro-flow analysis. *Fernando Maya* (Chiang Mai University) employed multisyringe FIA for fast oxalate determination based on surfactant-coated short columns and chemiluminescence detection, while *Petr Cholcholouš* (Charles University, Czech Republic) used longer monolithic columns in sequential injection chromatography for less limited separations, and compared solid-core porous particle Acsentis columns with monolith columns. *Kate Grudpan* described natural reagents for


flow analysis. Natural reagents derived from plant and animal tissues may be used with little or no refinement. Crude plant extracts may contain chemical compounds that enable their use as indicators in acid-base or redox titrations, or as chromogenic or fluorogenic agents. Use of natural reagents in a flow analysis system may prolong their active life by limiting their exposure to light or air.

**Flow gradients/microfluidics.** *Pawel Kościelniak* (Jagiellonian University, Poland) exploited the concentration gradient in flow analysis, and described methods to determine and correct for interferences. *Masaaki Tabata* (Saga University, Japan) described the effects of water-soluble polymers in a capillary flow system using aqueous mixed solvents, based on formation of microsolvent clusters. Simulation studies were done to better understand the systems. *Wiphawee Leesutthipornchai* (Chulalongkorn University) developed paper based microfluidic devices with silver nanoparticles for homocysteine determination, and achieved optical capture by a scanner or camera. *Thitima Maturos* (National Electronics and Computer Technology Center, Thailand) used three-dimensional hydrodynamic focusing on a planar PDMS-glass microfluidic microchip for cell manipulation and sorting applications. *Ditsayut Phokharatkul* (National Electronics and Computer Technology Center) used carbon nanotube microarrays in an anodized aluminum oxide nanopore electrode in a flow injection-based microfluidic device for rapid electrochemical iodide sensing. His colleague at the Center, *Chanpen Karuwan*, described droplet-based electrochemical detection in an electrowetting-on-dielectric microfluidic chip. *Napaporn Youngvises* (Thammasat University, Thailand) described innovative microfluidic systems incorporating multi-optical sensors for multi-analysis applications. *Anurat Wisitsoraat* (National Electronics and Computer Technology Center) reported on an FI based electronic tongue on a PDMS/glass chip with an in-channel electrochemical sensor array, and *Witsaroot Sripumkhai* (King Mongkut's Institute of Technology Ladkrabang, Thailand) described a thermal sensor array for temperature profile and flow rates measurement in a fluidic PDMS microchannel.

**Speciation.** *Marek Trojanowicz* (University of Warsaw, Poland) provided an overview of flow injection speciation analysis. The most advanced instruments for speciation analysis are modern hyphenated systems, combining atomic or mass spectrometers with high-performance separation methods. The flow injection set-up can be employed as an additional accessory in complex hyphenated instruments or instruments with a single detector, allowing simultaneous determination of different forms of elements (HPLC, CE), mostly for improvement of different sample pretreatment operations. Systems allow performing both speciation analysis of different oxidation states, determining free elements in ionic forms, *e.g.,* employing potentiometric detection, and determining different compounds in which the target element is bound. *Mohammad Abul Hashem* (Kumamoto University, Japan) investigated arsenic leaching from contaminated sediments by automated SIA to simultaneously monitor arsenite and arsenate, using hydride generation and subsequent flow analysis measurement using the molybdenum blue method. Both arsenite and arsenate were vaporized at pH 0 and selective vaporization of arsenite was at pH 7. *Adam Wiryawan* (Brawijay University, Indonesia) determined Cr(III) and Cr(VI) species by using dual mini columns and ICP-AES. Cr(VI) species can be collected by Analig resin at pH of 3-5, while Cr(III) species could not retained by Analig resin. The Cr(III) species was collected by Muromac A-1 at pH 4-9.

**Applications.** *Toshihiko Imato* (Kyushu University, Japan) described sensitivity enhancement of a surface plasmon resonance (SPR) immunosensor for the determination of nonionic surfactant by using polymerization of protein with transglutamase, to allow monitoring of low molecular weight compounds. A competitive immunoassay technique was adopted, where a casein conjugate of a target molecule (nonionic surfactant) binds to the antibody on the sensor surface competitively. The excess amount of the casein conjugate is transported to the second sensor channel, where transglutaminase is immobilized on its surface, and the casein-conjugate is polymerized by the enzyme reaction of transglutaminase on the second sensor surface. The enhanced sensor signal of the SPR sensor on the second channel is monitored. *Gulnara Safina* (Lund University, Sweden) used SPR for real-time study of lectin-carbohydrate interactions for the differentiation and identification of glycoproteins. *Orawon Chailapakul* reported on high throughput screening and analysis via collaboration of Thai researchers at six schools. She introduced the Asian Analytical Chemistry Network (http://aacn.asia), a network managed by the collaboration of the Japan Society for Analytical Chemistry (JSAC) and the Asian Conference on Analytical Science (ASIA ANALYSIS), and




invited participants to join the new Thai Association for Flow-Based Analysis (Thai-AFA). *Tadao Sakai* (Aichi Institute of Technology, Japan) applied flow-based techniques for diabetic diagnosis, by measuring albumin, creatinine, and glucose in urine using SIA and spectrophotometry. *Yasuhiro Iida* (Kanagawa Institute of Technology, Japan) determined cobalt ions with use of recombinant alkaline phosphatase as a recognition element. The histidine residue at position 334 of alkaline phosphatase was genetically modified to tryptophan (H334W) to respond to cobalt (II) ions as a cofactor of the enzyme. *Somchai Lapanantnoppakhun* (Chiang Mai University) reported on mapping Mae-Ping river waters, using portable units and a GPS system in an international collaboration, in which collaborators could access data at their desktops. *Makoto Kurihara* (Shizuoka University, Japan) determined iodide by FI by its catalytic effect on the oxidation of N-(3-sulfopropyl)-3,3',5,5'-tetramethylbenzidine using peroxomonosulfate. *Jessica Avivar* (University of the Balearic Islands) used a multisyringe flow injection-Lab-on-Valve system (MIA-LOV) for fully automated uranium determination at ultratrace levels. *Manuel Miro* of the same university described recent trends in automatic flow-through dynamic leaching tests for assessment of bioaccessible forms of trace elements in terrestrial environments. Recent trends in the development and application of a new methodological approach for risk assessment of trace elements in environmental solids following the guidelines of ISO 17402:2008, the so-called dynamic fractionation or dynamic bioaccessibility, were presented and critically compared with consolidated batchwise leaching tests. Different analytical techniques capitalizing on the various generations of flow analysis including flow-through microcolumn extraction, rotating column extraction and stirred-flow cell extraction were overviewed, and pros and cons for exploration of mobilizable metal forms within the framework of environmental availability were critically discussed.

*Norio Teshima* (Aichi Institute of Technology) determined formaldehyde spectrophotometrically based on its condensation with hydroxylamine followed by redox reaction with iron(III) in the presence of ligand. In place of 1,10-phenanthroline, he employed ferrozine to monitor the residual hydroxylamine for HCHO determination. As a result, a more sensitive FIA method for HCHO determination resulted because the molar absorptivity of the iron(II)-ferrozine complex is higher than that of iron(II) -phen complex. The detection limit for the alternative method was 1.60 μg $L^{-1}$. *Hermin Sulistyarti* (University of Brawijawa) developed an on-line FI method for cyanide and thiocyanate determination. Cyanide in an acid donor stream is directly converted to hydrogen cyanide which diffuses through a Teflon membrane into an acceptor stream containing nickel(II) in ammoniacal buffer to form tetracyanonickelate(II) which is detected spectrophotometrically at 267 nm, while thiocyanate requires oxidation by permanganate in the acid donor stream to form cyanide prior to detection. *Raquel Mesquita* (Universidade Católica Portuguesa) determined fluoride potentiometrically with a flow system for the on-line monitoring of fluorphenol degradation in a bioreactor via its fluoride degradation product. *Edgar Paski* (British Columbia Institute of Technology, Canada) provided guidance for instrument standardization for routine testing by FIA based methods.

**4. Poster presentations**

The posters covered the whole array of FIA-based and related techniques, of novel instrumentation development and new applications, including SIA, on-line sample preparation and separations, microfluidic and capillary based systems, sensors and biosensors, electrochemical, spectrophotometric, fluorometric and chemiluminescent detection and applications, and signal modeling.

In addition to the fifteen countries mentioned above, contributions were also made from Iran, Iraq, Russia, Switzerland, and South Africa, for a total of 20 countries.

**5. Poster awards**

The Committee for Student Poster Awards (Gary Christian, Tadao Sakai, Jaroon Jakmunee, Orawon Chailpakul, and Atitaya Siripinyanond) selected twelve outstanding student posters among numerous others for Poster Award certificates, given to: *Sira Nitiyanontakit* (Chulalongkorn University), *Uboltip Satipchan* (Thammaset University), *A. Y. Shishov* (St. Petersburg University), *Mayo Miyake* (Kyushu University), *Christina I. C. Silvestre* (Universidade de Porto), *Panida Phanwichartkul* and *Pornwilard M- M* (shared) (Mahidol University), *Kamonthip Sereenonchai* (Mahidol University), *Pongwasin Fuekhad* (Chiang Mai University), *Ruth Suárez* (University of the Balearic Islands), *Shunga Ikezuki* (Kanagawa Institute of Technology), *Nobuhiro Wada*(Okayama University), and *Jitlada Vichaspong* (Khon Kaen University).

**6. JAFIA awards**

The Japanese Association for Flow Injection Analysis presented their prestigious FIA Award for Science to *Petr Solich* and *Duangjai Nacapricha* at the Conference banquet. The FIA Honor Award for Science was presented separately to *Bo Karlberg* (University of Stockholm) and *Ari Ivaska* (Abo Akademi University) who were not present at the conference. In the 48$^{th}$ annual meeting of JAFIA (held in Osaka Prefecture University, November 27$^{th}$, 2009), the FIA Award for Science was presented to *Kei Toda* (Kumamoto University) and the FIA Award for Younger Researchers was presented to *Hiroshi Shiigi* (Osaka Prefecture University). The FIA awards consisted of a medal and a certificate.

**7. Exhibition**

Instruments and literature were exhibited by Bangkok High Lab Co., Ltd., representing FIAlab Instruments, and providing electrochemical, photometric and microfluidic systems (www.bangkokhighlab.com), eDAQ, providing detectors and software for FIA, electrophoresis, and chromatography (www.eDAQ.com), Fortunesci, representing international companies for fittings, sample preparation, and chromatography (www.fortunesci.com), Merck, for chromolith columns and high purity solvents for HPLC (www.merck-chemicals.com/thailand), Sithiporn Associates Co., Ltd., representing Foss (sa-spd-2@sithiphorn.com), and Thai Unique, Ltd., representing Lachat Instruments (thawatt@thaiunique.com).

**8. Publication of proceedings**

Papers for the conference will be submitted for peer review for a Special Issue of *Talanta,* with Guest Editors *Kate Grudpan (chief)*, *Duangjai Nacapricha*, *Orawon Chailapakul*, and *Jaroon Jakmunee*.

**9. ICFIA 17**

The International Steering Committee members, Gary Christian, Toshihiko Imato, Shoji Motomizu, Tadao Sakai, Kate Grudpan, Orawon Chailapakul, Jaroon Jakmunee, and Duangjai Nacapricha, confirmed that ICFIA 17 will be held in Krakow, Poland, July 3-8, 2011, hosted by Pawel Kościelniak at Jagiellonian University. For information, please contact koscieln@chemia.uj.edu.pl