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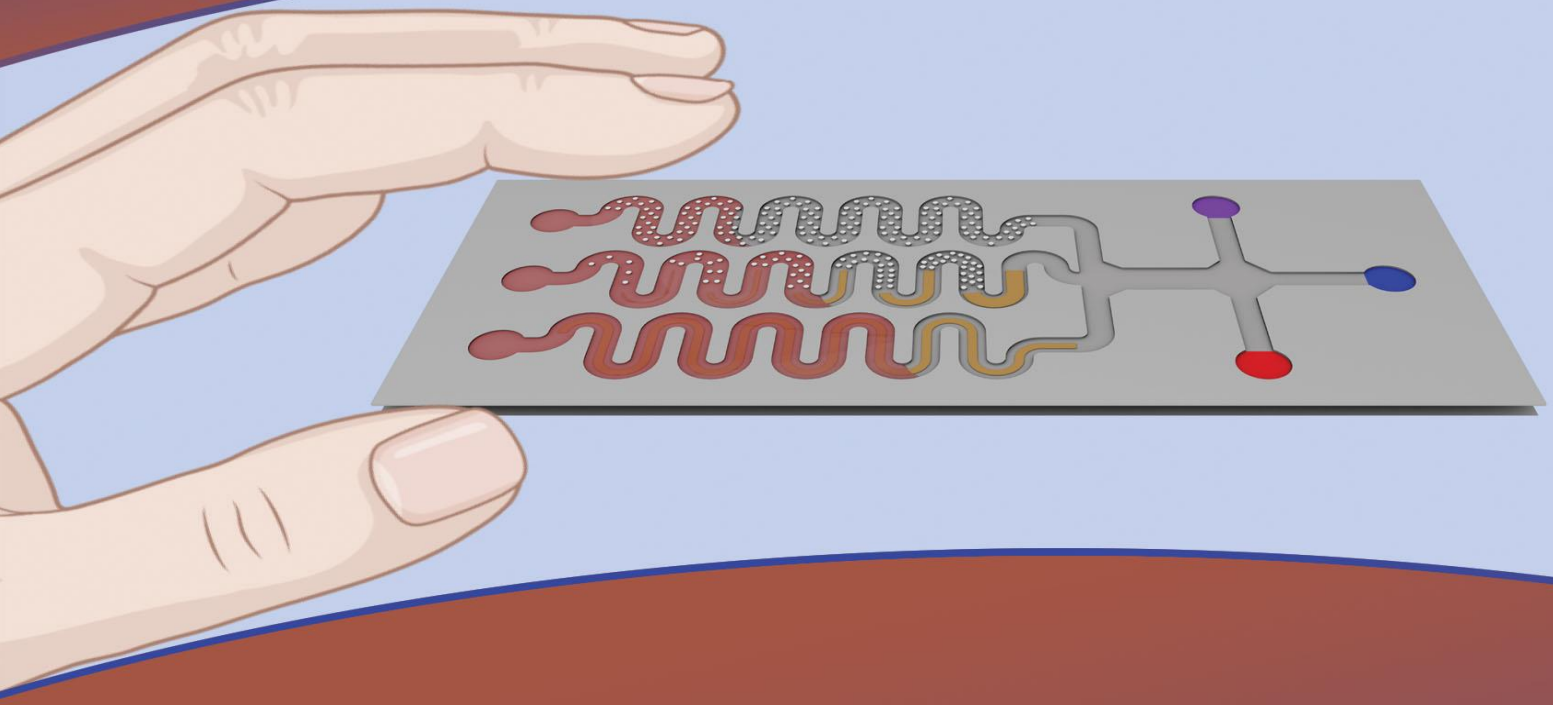
3rd monthly **Seminar!**

SWEDISH INTERNATIONAL DEVELOPMENT COOPERATION AGENCY



Title: Development of Microfluidic Paper-Based Analytical Devices for Affordable Point-of-Care Diagnostics

Date/ time: 31 July 2020/ 9:00 AM-11:00 AM, **How:** due to covid-19 pandemic, the seminar will be organized online using Microsoft Teams.

Who should attend?

Researchers, academic staffs, M. Sc./M. Eng. students and other senior students are recommended to attend. Interested person (RUPPer or non-RUPPer) can access the Google Form via the URL below for FREE registration BEFORE 27 July 2020.

https://docs.google.com/forms/d/e/1FAIpQLSdPY7DXYYnbFy7pLL6sU1JKcW2xEZANNkui812W34y9ZIHgDg/vi

Speaker: Veasna Soum, PhD in Chemistry, **Moderator:** Dr. Sunly Khimphun

(Dr. Veasna Soum has successfully defended his PhD dissertation at the Dept. of Chemistry, Sogang Univ., Seoul, Korea, and will attend the official graduation ceremony in August 2020. He has authored and co-authored several papers in renown scientific journals. See attached CV or google him for his publications!)

Join us...to learn and share scientific knowledge!

Contact Info.: Room 503 (STEM Building), Graduate School of Science, Royal University of Phnom Penh, Khan Tuol Kork, Phnom Penh.
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Development of Microfluidic Paper-based Analytical Devices for Affordable Point-of-care Diagnostics

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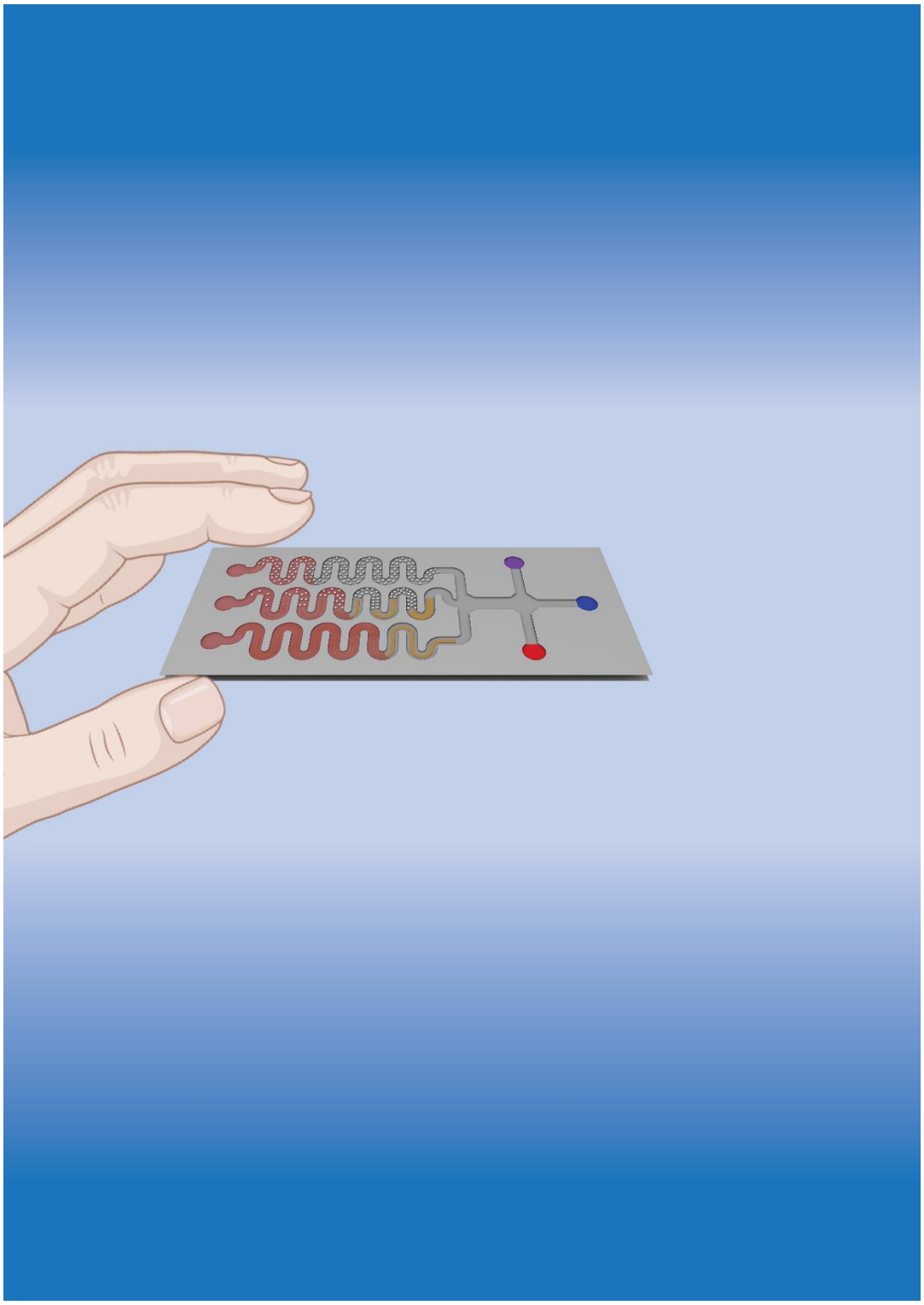
Abstract

Microfluidic paper-based analytical devices (μPADs) have become promising tools offering various analytical applications for chemical, biological and diagnostic assays, especially as point-of-care (POC) testing devices. Development of μPADs provides better engineering of POC sensing and testing devices for reducing fabrication cost, increasing detection sensitivity, realizing a wild range of assay protocols and to the end promising toward high-throughput diagnostic screening devices. Herein, after we massively reviewed developments of μPADs especially for POC devices, we showed our own novel methods for fabrication of the comprehensive paper-based lab-on-a chips (LOCs) equipped with biosensors: electrochemical sensors (ECSs) and colorimetric sensors, and paper-based microfluidic devices: paper-based continuous-flow microfluidic devices (p-CMFs) and paper-based digital microfluidic devices (p-DMFs). The fabricated biosensors were successfully used to detect various diagnostic analytes such as glucose and methyl paraoxon (MPO) that are the critical clinical indicators for diabetes and nerve agent simulant, respectively. The fabricated microfluidic devices were used to handle fluid samples in programmable way and capable for usages of a wide range of analytical assay protocols both single-step and multiple-step assay. Our approaches opened an avenue for affordable μPADs for POC testing for medical screening especially for resource-limited settings.

Keywords: microfluidic paper-based analytical devices; immunoassay; biomarkers; continuous-flow microfluidic device; digital microfluidic device; printing of nanomaterial ink; lab-on-a-chip

Graphical abstract:



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EDUCATION

PhD	Sogang University, Chemistry	August 2020
MS	Sogang University, Chemistry	February 2017
BS	Royal University of Phnom Penh, Biochemistry	July 2013

HONORS AND AWARDS

1. The Chemistry Award for Outstanding Graduate Student, Graduate student of Sogang University, 2018.
2. Best Poster Award of The International Conference on Flexible and Printed Electronics, Conference poster presentation, 2017.
3. The DOW Chemical-Sogang Award for Outstanding Graduate Student, Master graduation thesis, 2016.
4. Best Poster Award of The 10th International Meeting on Electrowetting 2016, Conference poster presentation, 2016.

RESEARCH INTERESTS

1. Nanomaterial deposition by printing methods: Fabrication of paper-based electrochemical sensor/ Applied for detection of glucose that is indicator for diabetes diagnosis/ Low cost

2. Microfluidic chip fabrication: Fabrication of paper-based digital microfluidic fabrication/ Biochip for point-of-care devices/ Applied for automation of biofluid sample handling/ Low cost

3. Microfluidic chip fabrication: Controllable microfluidic device/ Paper-based continue-flow microfluidic devices/ Applied for control biofluid sample transportation without need external power source/ Capable for multi-step chemical and biological assays/ Detection of glucose and chemical warfare agent/ Detection of cancer markers.

4. Surface coating of high temperature stable polymer: Heat stable and glossy surface paper substrate for printing nanomaterial ink/ For printed flexible electronics

PUBLICATIONS

Journal Publications

1. Boobphahom, S.; Ly, M.N.; **Soum, V.**; Pyun, N.; Kwon, O.-S.; Rodthongkum, N.; Shin, K. Recent Advances in Microfluidic Paper-Based Analytical Devices toward High-Throughput Screening. *Molecules* **2020**, 25, 2970, https://doi.org/10.3390/molecules25132970.

2. **Soum, V.**; Park, S.; Brilian, A.I.; Choi, J.Y.; Lee, Y.; Kim, W.; Kwon, O.S.; Shin, K. Quantitatively controllable fluid flows with ballpoint-pen-printed patterns for programmable photo-paper-based microfluidic devices. *Lab Chip* **2020**, *20*, 1601-1611, doi:10.1039/d0lc00115e.

3. Yukird, J.; **Soum, V.**; Kwon, O.S.; Shin, K.; Chailapakul, O.; Rodthongkum, N. 3D paper-based microfluidic device: a novel dual-detection platform of bisphenol A. *Analyst* **2020**, *145*, 1491-1498, doi:10.1039/c9an01738k.

4. **Soum, V.**; Park, S.; Brilian, A.I.; Kwon, O.S.; Shin, K. Programmable Paper-Based Microfluidic Devices for Biomarker Detections. *Micromachines (Basel)* **2019**, *10*, 516, doi:10.3390/mi10080516.

5. **Soum, V.**; Park, S.; Brilian, A.I.; Kim, Y.; Ryu, M.Y.; Brazell, T.; Burpo, F.J.; Parker, K.K.; Kwon, O.S.; Shin, K. Inkjet-Printed Carbon Nanotubes for Fabricating a Spoof Fingerprint on Paper. *ACS Omega* **2019**, *4*, 8626-8631, doi:10.1021/acsomega.9b00936.

6. **Soum, V.**; Kim, Y.; Park, S.; Chuong, M.; Ryu, S.R.; Lee, S.H.; Tanev, G.; Madsen, J.; Kwon, O.S.; Shin, K. Affordable Fabrication of Conductive Electrodes and Dielectric Films for a Paper-based Digital Microfluidic Chip. *Micromachines (Basel)* **2019**, *10*, 109, doi:10.3390/mi10020109.

7. **Soum, V.**; Cheong, H.; Kim, K.; Kim, Y.; Chuong, M.; Ryu, S.R.; Yuen, P.K.; Kwon, O.S.; Shin, K. Programmable Contact Printing Using Ballpoint Pens with a Digital Plotter for Patterning Electrodes on Paper. *Acs Omega* **2018**, *3*, 16866-16873, doi:10.1021/acsomega.8b02592.

8. Cheong, H.; Oh, H.; Kim, Y.; Kim, Y.; **Soum, V.**; Choi, J.H.; Kwon, O.S.; Shin, K. Effects of Silicone Oil on Electrowetting to Actuate a Digital Microfluidic Drop on Paper. *J Nanosci Nanotechnol* **2018**, *18*, 7147-7150, doi:10.1166/jnn.2018.15500.

9. Ruecha, N.; Lee, J.; Chae, H.; Cheong, H.; **Soum, V.**; Preechakasedkit, P.; Chailapakul, O.; Tanev, G.; Madsen, J.; Rodthongkum, N., Shin, K. Paper-based digital microfluidic chip for multiple electrochemical assay operated by a wireless portable control system. *Adv. Mater. Technol.* **2017**, *2*, 1600267.

10. Jo, A.; Chae, H.; Kim, Y.; Kim, H.; Paek, S.; **Soum, V.**; Jang, W.; Ryu, S.R.; Kwon, O.S.; Shin, K. Formulation of Conductive Filament Composited of Thermoplastic with Carbon Black for a Simple 3D Printing Electrical Device. *J Nanosci Nanotechno* **2016**, *16*, 8415-8418, doi:10.1166/jnn.2016.12532.

11. H Chae, M.J., H Cheong, **Soum, V.** S Jo, H Kim, T Kim, K Kim, S Jeon, OS Kwon, K Shin. Thermoelectric temperature sensors by printing with a simple office inkjet printer. *TechConnect Briefs* **2016**, *4*, 151 - 155.

PATENTS

1. 신관우, **V. Soum**, 권오선, 김창호, Composition for modifying a substrate surface containing polyether sulfone and a method for modifying the surface using the composition, *KR Patent Application*, **2020**, 10-2020-0072422 (2020-06-15).
2. Shin, K.; **Soum, V.**; Lee, M.N.; Kim, C.; Kwon, O.S.; Oh, B.K.; Pumpless Polymerase Chain Reaction System Using No Pump, *KR Patent Application*, **2020**, 10-2020-0064064 (2020-05-28).
3. 오병근, 신., 이명준, **Soum, V.**, 김영기. 3D paper based Microfluidic device for Thioredoxin detection by Enzyme linked immunosorbent assay (면역 화학 진단법을 이용한 표적 항원 검출용 종이기반 3 차원 구조의 미세칩과 이를 이용한 표적항원 검출 방법). KR Patent 10-2088277-0,000: 2018; https://doi.org/10.8080/1020180048965?urlappend=en.
4. 신관우, **Soum, V.**, 권오선, 정해나, 김윤표. MICROFLUDIC DEVICE (미세유체 장치). KR Patent 10-2044344-0,000: 2018; https://doi.org/10.8080/1020170060705?urlappend=en.

PRESENTATIONS AND INVITED LECTURES

2. Paper Presentation, "Gold Nanoparticle Synthesis on Paper-based Digital Microfluidic Chip Platform," The 10th International Meeting on Electrowetting 2016, June 2016.

1. Paper Presentation, "Programmable paper-based microfluidic devices with printed patterns for analytical assays," Korean Chemical Society, October 2019.