QCAM
Quebec Centre for Advanced Materials

Newsletter

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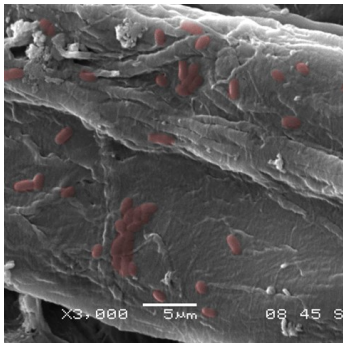
COVID-19 - a materials science perspective

Hand Drying: The Neglected Side of Hand Hygiene

Dr Roger Gaudreault, QCAM associate member

Public health as well as the economic impact of outbreaks are of major concern. Few examples of outbreaks and their estimated cost since 1990, are: USA - E. coli 0157; $1.6 billion in 1991-99; Peru - cholera, $770 million in 1991; Asian SARS - $39 billion in 2003; the A/H1N1 influenza pandemic in 2009, and, more recently, COVID-19 Coronavirus with 2,994,690 known cases and 207,431 deaths on April 27th 2020 (source). Health and financial authorities are taking drastic measures to prevent further spreading of COVID-19. Not surprisingly, the overall impact on our society is likely to be unprecedented!



Bacteria on cellulosic fibres. Author provided

One of the basic rules to minimize the propagation of COVID-19 is hand hygiene. There are two sides to hand hygiene: ***washing and drying***. Most of us recognize the importance of hand washing mainly because throughout our lives we have been told 'wash your hands'! However, the drying side, which is also very critical to reduce the propagation of bacteria and viruses, is generally neglected.

Why is hand washing so important? Because getting rid of bacteria and viruses is required to reduce the risk of transmitting diseases.

Why is hand drying so important? Because it's an essential complementary step in hand washing. Residual moisture left on hands that are not properly washed and dried is a determinant factor for hand hygiene. The behavior of people in public washroom also has to be considered. More importantly, it is imperative to remind that the ultimate goal of hand drying isn't to remove water from your hands, but to prevent the spread of infectious diseases.

Which drying method is best? There are four main

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Killing touch: materials vs microbes

Dr Matteo Duca, QCAM scientific affairs director

How long does a virus remain viable outside the body? This question has come to the fore as the world scrambles to contain the COVID-19 outbreak. Answering it will be instrumental in inspiring public health measures, as well as in protecting health workers.

Antimicrobial surfaces: closing the door on contagion. Author provided

Available data on SARS-CoV-2 are still scarce. A review of studies on other coronaviruses suggests that these viruses can persist up to several days in the most favourable environmental conditions (low temperature, high humidity). A word of caution: detecting viral RNA on a given surface does not imply viability. A letter to the *New England Journal of Medicine* provides some insight into the persistence of SARS-CoV-2 under controlled laboratory conditions. These preliminary data suggest that the viral load decays most slowly on stainless steel and plastic; the decay is faster on cardboard. Instead, the viral load decreases extremely rapidly on copper.

This is intriguing, but not surprising: the medical literature from Ancient Greece reports several uses of this metal in dressings to treat ulcers and wounds. In the 1800s, copper smelters did not contract cholera during outbreaks. Since 2008, the US Environmental Protection Agency considers copper and its alloys as « metallic antimicrobial agents ».

What underpins copper's formidable antimicrobial properties? Little is known about the exact mechanism of « contact killing »: probably, it involves membrane disruption. Oxidative damage may also play a role, thanks to the copper-catalysed release of reactive oxygen species.

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Annual symposium: rescheduled for the autumn—more information to follow

FOCUS—INTERNATIONAL WOMEN'S DAY, pages 3-4

(Continued from page 1)

methods: paper towel: warm air dryer; jet air dryer: and reusable cloth towel. Although there have been contradictions in the literature over the last 50 years, the majority of the studies conducted under realistic conditions showed that the use of paper towel is a better drying method to minimize the spreading of bacteria, compared to warm and jet air dryers.

To conclude, the Centers for Disease Control and Prevention (CDC) estimates that 80 percent of all infections are transmitted by hands, hence, it is critical to wash your hands but as important to properly dry your hands: the neglected side of hand hygiene!

Adapted from: R. Gaudreault, Tissue World, June/July 2009, p.44

(Continued from page 1)

Apart from simple, elegant copper, researchers have developed an astonishing range of antimicrobial surfaces. Working with international colleagues, QCAM Prof. Diego Mantovani (U. Laval) engineered a surface coating combining TiO_2 nanotube arrays and Ag nanoparticles immobilised in a polydopamine film. This composite layer protects a $Ti_{7.5}Mo$ alloy, widely used in biomedical applications. Ag nanoparticles interfered with cell adhesion and effectively killed *Candida albicans* and *Streptococcus aureus* in laboratory tests. Another example of contact killing.

Containing the COVID-19 outbreak will call for a holistic approach and antimicrobial surfaces will surely be part of the solution.

In brief—COVID19

FRQNT has announced that strategic clusters will receive funding for an additional year (press release here)**. The mid-term report is no longer due this year.**

"Test, test, test", say the WHO. A team including QCAM member Prof. Jean-François Masson (UdeM) has secured CIHR funding to design an analytical device for rapid coronavirus testing : "In a matter of minutes, the device could indicate whether the sample contains coronavirus antibodies, an operation that currently takes several hours", Prof. Masson points out.

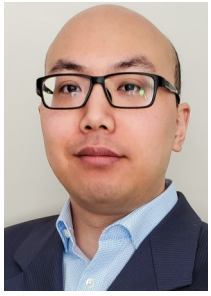
NSERC has launched a special Alliance call for proposals concerning research related to COVID-19. Contact Matteo Duca for more info.

Nanotechnology against COVID-19: Mohamed Siaj and Nadi Braidy talk about it on Radio-Canada.

QCAM (post)doc: what next?

Julia Del Re, Research Scientist, AIM Solder—QCAM industrial member After completing my PhD in molecular electronics at McGill with QCAM member Prof. Amy Blum in 2015 I briefly worked as a research assistant there before transitioning to industry. In 2017 I was hired by AIM Solder to work on the development of electronic assembly materials because of my research background. Industrial research is very different from academic research in that the former is profit-driven while the latter is knowledge-driven, so it required me to shift the way I think about research problems. One of the things I like most about industry is the opportunity to work on research projects that have applications in the real world. It is fascinating to see the products we develop at AIM being used in everything from cars to medical devices.

E-mail matteo.duca@umontreal.ca to submit your story!



Ngoc Duc Trinh, Project manager, Printability and Graphic Communications Institute (ICI) was awarded a Ph.D. in chemistry from UQAM in 2015 under the supervision of Prof. S.B. Schougaard (QCAM member). Between 2011 and 2014, he also held the position of student representative of the QCAM executive office. Then, he did a postdoctoral internship at the University of Montréal under the supervision of Profs. D. Rochefort, A. Badia and M. Dollé (QCAM members). His graduate and postdoctoral studies focused on lithium-ion batteries. Since September 2017, he is now a project manager at the Printability and Graphic Communications Institute (ICI). His expertise is applied in the manufacturing by roll-to-roll printing processes of fully printed batteries adapted to smart packaging. These devices make it possible to continuously provide additional information (temperature, humidity, oxygen, etc.) on the conditions of packaging throughout the supply chain to consumers. Within the multidisciplinary R&D team, he contributes to the scaling up manufacturing by rotary printing processes and carries out the technology transfer to the industrial partners.

Two outstanding women in science from QCAM

On the occasion of the International Women's Day, two researchers tell us how they achieved recognition on a national scale.

We are proud of all the women who have contributed so much to QCAM's achievements

Amélie Augé (UdeS)

Run, jump, throw…such is the slogan of some athletics federations. If I had to come up with a slogan describing my PhD, I'd add "explore". Yet, if I had to pick one single word conveying what I've felt over the last 4 years, I'd go for "fun".

As a student athlete at Université de Sherbrooke, I've been in two teams since the summer of 2015: Prof. Zhao's research group and the Vert et Or athletics club. Motivated, but also so nervous, I could never have imagined the wonderful adventures I would have in chemistry and athletics.

The very first time I stepped in the UdeS sports centre, I very much looked forward to becoming one of these student athletes who have left their mark in the history of UdeS. From the lab to the track, from the track to the lab, passion and commitment fuelled my doctoral track record.

No hurdle is impossible to overcome. On the right: Amélie with Julie Payette

In the lab, I pursued research on hybrid nanoparticles composed of a thermosensitive copolymer, poly (acrylamide-co-acrylonitrile). The originality of my research lies in the fact that the positive volume transition of these nanoparticles is triggered by near infrared light, paving the way for several potential applications, particularly in the biomedical field.

On the track, it was my coach, Annie Potvin, who helped me to train for the pentathlon event of the Canadian University Championships .

First papers, first medals at the "Canadians", first awards… my 2018 was a turning point in my academic career since my wishes came true. My portrait was hung on the walls of the UdeS sports centre. Selected as student athlete and athlete of the year, I received the Rector's award. This prize was followed by my nomination to the select group of the Top 8 Academic All-Canadians. Presented by the Governor General of Canada, Julie Payette, this commendation recognises the academic and sporting excellence of the 8 best student athletes across Canada.

Like a chemical reaction, my equilibrium between sport and science has always been perfectly balanced over the last 4 years. A few days before obtaining my degree, I have mixed feelings: the excitement at the prospect of exploring new ideas and the sadness at the fact of leaving the environment so conducive to such a perfect balance between sport and research.

(text provided by Amélie Augé, translation by Matteo Duca)

Yuan Fang (McGill)

"Really delighted, honored and thrilled for receiving this award". Yuan has a beaming smile as she remembers that special day. We meet her at McGill, in the Ruttan room. This setting, the venue of formal lectures, seems to resonate with Yuan's words. She is describing the grand ceremony she attended as the 2019 Alice Wilson awardee. The «Royal Society of Canada's celebration of Excellence and Engagement» was held in Ottawa from the 21st to 24th November 2019. Yuan received the Alice Wilson Award in recognition of "outstanding academic qualifications in the Arts and Humanities, Social Sciences or Science". The award is named after a distinguished geologist who became the first female Fellow of the Royal Society of Canada in 1938.

Yuan Fang and the Alice Wilson Awards

The Alice Wilson Award is the latest accolade won by Yuan, who has also secured the Top-ranked Female NSERC Postdoctoral Fellowship Award. Yuan is keen to stress that CSACS, QCAM's previous incarnation, provided support in the early stages of her graduate research. In addition, Yuan emphasizes the key role played by mentors in her career. First and foremost, Louis Cuccia, QCAM member and Concordia professor, who first recognized Yuan's potential as a researcher. It was Louis' advice that inspired Yuan to pursue a PhD in Steven De Feyter's group at KU Leuven (Belgium) (2013-2017). Yuan studied molecular assemblies on surfaces using scanning probe microscopy techniques. During this project, Yuan could rely on the invaluable help of another mentor, Oleksandr Ivasenko, a postdoctoral researcher at KU Leuven.

Yuan tells us about one of the highlights of her PhD, a *Nature Chemistry* paper entitled "Dynamic control over supramolecular handedness by selecting chiral induction pathways at the solution-solid interface" (2016). The synthesis of a wide variety of chiral alkoxylated dehydrobenzo[12] annulene derivatives (DBA) called for the help of Japanese collaborators. It was a veritable *tour de force*, Yuan recalls, stretching over more than a year. Then, Yuan and her colleagues unveiled a fascinating molecular sleight of hand: a previously unreported chiral amplification pathway. In fact, chemists had known that, at the solid-solution interface, a small amount of chiral molecules can nudge surrounding achiral fellows into a uniform handedness, leading to a homochiral porous network. This is often referred to as the *sergeant* and *soldier* mechanism. However, if you combine this approach with thermal annealing, it can surprisingly flip the overall chirality to the opposite handedness under certain conditions. This chiral switching mechanism has potentially far-reaching implications for the fabrication of homochiral surfaces.

Among Yuan's papers, there is one that stands out as a perfect example of QCAM collaborations: a *Nanoscale* article on "Alkyl chain length effects on double-deck assembly at a liquid/solid interface". This work brought together as many as four QCAM members. On top of that, its graphical abstract featured a pencil drawing of a double-decker encircled by gracefully twisting molecules. "It was Louis' nephew who drew it", Yuan tells us.

QCAM duo Perepichka (left) and Cuccia (right) with Yuan at the reception of the Royal Society of Canada

Looking ahead, Yuan hopes to soon secure a faculty position and keeps working hard in her McGill laboratory towards this goal. Her current research focuses on the self-assembly of π-conjugated Covalent Organic Frameworks (COFs) at the surface and their characterization by STM and AFM. She has gone a long way since Louis Cuccia, "a motivating, forward-looking supervisor", encouraged her to do a PhD. Yuan's advice to QCAM students reading this article is simple: "when you look for a supervisor, do not necessarily choose someone very famous; rather, go for a true mentor vision and a human touch".

(Yuan was interviewed by Matteo Duca)

Listen to Amélie Augé's and Yuan Fang's talks at QCAM annual symposium

Bulletin board

A warm welcome to the new director Theo Van de Ven (McGill) and to the new regional representatives. The new co-director is Mohamed Siaj (UQAM). Heartfelt thanks to the former director, Michel Lafleur (UdeM), for his invaluable contribution to the development and success of QCAM.

Region	Representative	Assistant representative
McGill/Concordia	Louis Cuccia (Concordia)	Ashok Kakkar (McGill)
UdeM/ETS/UQAM/Poly	Antonella Badia (UdeM)	Ricardo Izquierdo (ÉTS)
UL/UQTR/UQAR/UQAC	François Brouillette (UQTR)	Marc-André Fortin (UL)
UdeS/INRS	Patrick Ayotte (UdeS)	Fiorenzo Vetrone (INRS)

Quantum of shoelace Orgiu's and Perepichka's groups weave Schiff bases into macrocycles to make patterned graphene. This strategy can pave the way for tailored quantum materials. Read their *ACS Nano* paper and get hooked on these fascinating motifs.

A layer of complexity to tame lithium deposition on Li-metal anodes. Prof Sun and his group lassoed Li^+ with an electrolyte additive, driving the growth of a stable SEI. A report in *Nature Communications*.

Gauge the cage Ever wanted to track the progress of a mechanochemical MOF synthesis? Then this *Chemical Science* paper is for you. The Friscic group shows how to make the most of a manometric measurement. Bonus result: the discovery of unexpected reaction mechanisms.

Cobalt rules at INRS: 1D and 2D Co-based nanohybrids punch above their weight as electrocatalysts for hydrogen evolution in photoelectrochemical cells and electrolysers. An *Advanced Functional Materials* paper co-authored by Tavares's and Rosei's groups with Chinese collaborators.

FRQNT "Relève étoile Louis-Berlinguet" prize

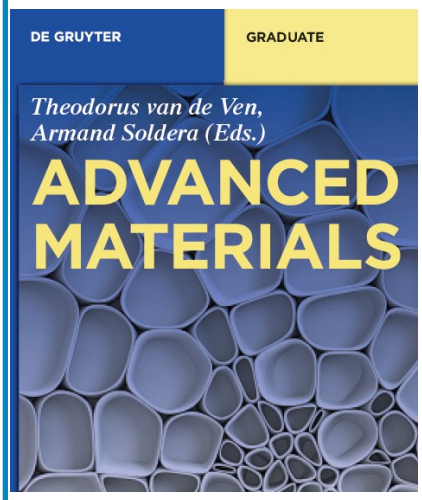
Four QCAM students have won it since June 2019!

- *Yao-Yu Xiao* and *Zhi-Chao Jiang* (Université de Sherbrooke, March 2020)
- *Qingzhe Zhang* (INRS, January 2020).
- *Fan Yang* (INRS, June 2019)

New members!

- *Dr Norma Mendoza* (industrial, Raymor)
- *Prof. Alain Rochefort* (regular, Polytechnique)
- *Maritza Volel* (regular, Collège Montmorency)

The book *Advanced Materials* is out!



Synopsis: To foster the use of performing materials, chemists, physicists, biologists, engineers, numerical experimentalists, must combine their skills to rationalize the design of materials. This book reveals the powerful energy stemming from the research in Quebec in the domain of materials in 2019. It is aimed at exposing research in advanced materials developed by members of CQMF/QCAM. This book is ideal for scientists and engineers of materials science, chemistry, physics, and engineering, and students of these disciplines. **Editors:** Theo Van de Ven, Armand Soldera **Publisher:** De Gruyter, 120.11 CAD (paperback).

International partnerships:
QCAM in talks with Université de Bordeaux

QCAM and Bordeaux researchers have co-authored 26 papers since 2016. In 2021, three students will receive QCAM travel grants to attend the Bordeaux summer school Advanced materials for energy storage and conversion *QCAM member Jacques Huot will be one of the speakers*