



IIHCC

Solving problems that exist at, and along, the interdependencies between humans, community, and infrastructure to ultimately improve quality of life.

Vol. 3 No. 2 April 2020

What's Inside

Cluster Hire Spotlight: Rebecca Cai
Smart Cross-Laminated Bamboo by Jonas Hauptman
Rethinking Intelligent Infrastructure in Time of COVID-19
ICAT Rapid Response grant call
IIHCC In The World

Calendar

5/01 | ICAT Rapid Response grant call
5/04 | [ICAT Creativity + Innovation Day](#)

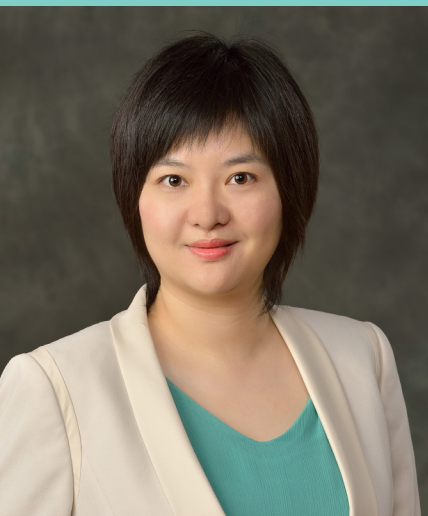
If you have any questions, comments, or concerns, please contact us:

IIHCC Director: Aki Ishida
aishida@vt.edu

Project Analyst: Jordan Erisman
jseris44@vt.edu

For more information about IIHCC, [visit our website](#)

CLUSTER HIRE SPOTLIGHT



Wenjun (Rebecca) Cai

Assistant Professor

Department of Materials Science and Engineering

PhD, Material Science Engineering | *University of Illinois at Urbana-Champaign*

BS, Material Science | *Fudan University, China*

Email caiw@vt.edu

How do you see your work contributing to the goals and vision of IIHCC?

For any future human-centered community, the interaction between the community and infrastructure unequivocally relates to materials. For any new technology there is a relation to new materials. Within this “new materials” category, we work on structural materials. Metals is a very traditional field; humans learned how to use metals several thousands of years ago. However as of today, there is still so much we do not know about metals. We are at a very exciting stage where, with a data science approach coupled with advanced materials analyzation tools, we can probe things at a scale and environments that we were not able to do in the past. The combination of all these is really driving materials discovery for having more recyclable, lighter-weight, stronger, and more robust metals. These metals are then used for healthcare, for infrastructure, for energy applications, and interaction with humans. So, I contribute to one of the corners of this very big picture.

What other areas outside of your discipline would you entertain for future research and proposal work?

I am interested in the biomedical aspect of metal research. Biomedical implants are something that we have been working on for a few years. One of the technologies we are developing is implantable metal that is also biodegradable. Conventional metals that doctors put in your body when you fracture a bone are either stainless steel or titanium alloys. Once your bones are healed, they have to do a secondary surgery to take it out. The idea is to find a metal that is going to hold the bone for as long as we need and then completely degrade in the body so that secondary surgery is avoided.

Another thing that has drawn my attention lately is the interaction with viruses and metal surfaces, so metal-microbiology interaction. With coronavirus, [you might have heard that it lives on different surfaces for different amounts of time](#). One of the metals that can actually kill and deactivate viruses, including coronavirus, is copper alloy. In order for that to work, you have to corrode copper. The corrosion rate of these metals will have a beneficial or designed efficacy to deactivate or kill viruses.

Physical
Metallurgy

Tribology,
Corrosion,
and
Tribocorrosion

Materials
Deformation
and
Degradation

Materials
Characterization

Mechanical
Testing
and
Fracture
Mechanics

Photo courtesy of *Smart Cross-Laminated Bamboo* team



Smart Cross-Laminated Bamboo

Last year, researchers [Jonas Hauptman](#) (an IHCC cluster hire interviewed in the June 2019 newsletter issue), [Daniel Hindman](#), [Katie MacDonald](#), [Tom Hammett](#), and [Kyle Schumann](#) submitted their proposal, titled *Smart Cross-Laminated Bamboo*, to the Science, Engineering, Arts, and Design (SEAD) grant, a collaborative call for grant proposals between IHCC, the Institute for Creativity, Arts, and Technology (ICAT), and Creativity + Innovation Destination Area (C+I). Since receiving the grant, the team has celebrated several more successes, including promising research findings, external grants, and an [article in Metropolis](#), a New York-based magazine focusing on architecture and design.

The goal of the project is to develop and evaluate the performance of Smart Cross-Laminated Bamboo (SCLB) compared to Cross-Laminated Timber (CLT), the process of gluing several pieces of solid timber together, and Structural Insulated Panels (SIP), panels with foam insulation placed between two composite wood layers. Composite lumber panels, made with wood from younger and smaller trees that would otherwise lack structural strength as building materials, are more sustainable and efficient than conventional solid lumber. Though bamboo is not yet a material prevalent in high-rise construction, the team is optimistic this may change through their research, and there is also promise in the area of residential construction. “We can create something that lies between [CLT and SIP],” states Dr. Hindman. “CLT is a little overkill for residential space where the building requirements are less structurally demanding.”

The research team began the research project with a series of tests to determine the structural performance of two



Photo courtesy of *Smart Cross-Laminated Bamboo* team



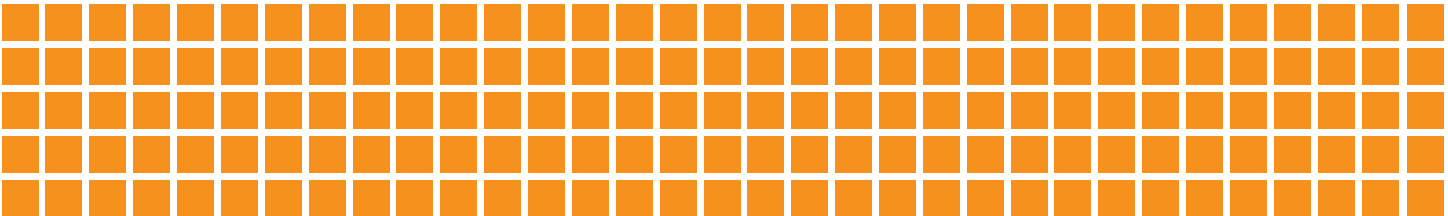
Photo courtesy of *Smart Cross-Laminated Bamboo* team

species of tropical bamboo and the bonding capabilities of several adhesives. From these tests, the team fabricated two three-foot long bamboo panels (not cross-laminated) using whole bamboo stalks to test and confirm conclusions from previous tests and provide initial data. Preliminary tests on the panels revealed results in favor of the research team's goals. Motivated by the promising findings, the team is currently designing and fabricating several six-foot long panels using cross-lamination techniques with whole or longitudinally split poles of bamboo for the next round of evaluation and testing.

However, the research project's success has not come without unique challenges. Natural variation in the size and shape of individual poles means significant time is spent sorting to find complimentary pieces for panels and innovating with processing techniques traditionally used for lumber. Additionally, the internal structure and composition of bamboo means varying structural performance levels that must be accounted for when constructing panels. As Dr. Hindman aptly puts it: "We are trying to account for natural variation and put it into standardized form."

Despite a few challenges on the way, the research team is very optimistic about their path forward. At the conclusion of this phase of the research, the team will have a reliable process for converting Vietnamese bamboo into SCLB. From that point forward, the project will likely take two different directions. The first will be to continue in discussions with entrepreneurial partners toward the development and commercialization of a high throughput panel system. The second will be the development of a democratized process for local communities to adapt SCLB to available species of bamboo and the specific resources of their economies. The team hopes that these two strategies combined will help disperse the technology at the scale necessary to significantly reduce the impacts of building around the globe.

More information on the project and other sustainable building materials can be found in this [Metropolis article](#).



RETHINKING INTELLIGENT INFRASTRUCTURE IN TIME OF COVID-19

Message from IIHCC Director Aki Ishida

The impact of COVID-19 on both the urban and rural communities brings to question how we design intelligent infrastructure. As Thomas Fisher, a professor of architecture and director of the Metropolitan Design Center at the University of Minnesota, wrote in his prescient article “[Viral Cities](#)” in 2010, history tell us that epidemics change infrastructures. For example, cholera and malaria outbreaks in the 1860s in New York City resulted in infrastructure improvements and zoning laws to control overcrowding in buildings. The impact of the current outbreak in the US is concentrated in the most vulnerable populations of two communities: the most dense, [urban areas](#), and the most isolated, [rural areas](#). Besides other factors including pre-existing health conditions and insurance, the likelihood of both infection and death from COVID-19 is closely tied to infrastructure. The younger generations in particular are choosing to live with small footprints in urban areas, embracing shared living spaces and car rides and public transportation. Cities have also been and continue to be a home to low-income, hourly-wage workers who often live in apartments with multi-generation families. Unfortunately, what makes these cities great – the density, the diversity, and the lively public life that come with it – also increases possible exposure to viruses.

In contrast, isolated rural communities may initially be protected from the spread of virus, but once the virus spreads, those who are ill have limited medical care. Many rural areas in the US have [closed their hospitals](#) due to costs, limiting access to testing and treatment. Furthermore, in both rural and urban areas, telecommuting and online learning are often not possible for those with low-income, either because they cannot afford internet service, or their remote rural areas have not yet been wired. This digital divide further deepens the economic divide for those who are left behind.

How do we design intelligent infrastructure for the post-pandemic world—including housing, transportation, healthcare access—to prepare for future pandemics? As people crave for human contact during the current social distancing, will we design urban housing and public spaces with more distance between people? How could telemedicine expand access to preventive healthcare in rural areas? As American homeowners added half-bathrooms to wash hands during the early 20th century influenza outbreaks, will COVID-19 change our attitudes about hygiene and the engineering of plumbing systems? How will we design autonomous vehicles, train cars, and aircraft to protect communities from diseases and contribute to public health discourse? This time of pandemic presents challenges and opportunities for Virginia Tech’s IIHCC to rethink intelligent infrastructure that truly serves diverse human communities.

ICAT RAPID RESPONSE GRANT CALL

The connection between people separated by distance has been a research interest of the Institute for Creativity, Arts, and Technology (and its Centers for Human Computer Interaction and for Educational Networks and Impacts) for a while, but the COVID-19 pandemic has amplified this challenge and increased its urgency. Given this, ICAT is implementing a rapid response call in three areas of immersive connections for up to \$10,000 per area. Please feel free to share this information with anyone that would be interested. The due date for these proposals is May 1, 2020. See the PDF attached for more information and full information can be found at the following [link](#).



IIHCC IN THE WORLD

[Artificial intelligence yields new antibiotic](#) | Researchers developed a machine learning platform to pick out potential antibiotics for a multitude of bacteria.

[Assessing the problem of poor sanitation](#) | Researchers are looking into better approaches to more accurately and effectively determine the number of people exposed to health risks due to poorly-managed sanitation systems.

[Cities after coronavirus: how Covid-19 could radically alter urban life](#) | Pandemics have had significant effects on society throughout history. What future effects will Covid-19 have on our current society and daily lives.