International Conference on "Materials for Humanity" hosted by MRS Singapore

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"Materials for Humanity 2021 (MH 21)," a virtual conference organized by the Materials Research Society of Singapore (MRS-S), was held in July. In response to the COVID-19 pandemic, the Meeting chairs—Tim White of Nanyang Technological University and president of MRS-S, Feng Yuanping of the National University of Singapore (NUS) and vice president of MRS-S, and B.V.R. Chowdari of NUS and president emeritus of MRS-S—issued a statement that the goal of the international conference was "to emphasize the role of materials innovation and deployment in tackling global challenges in health, climate change and the environment." Apart from the virtual format of prerecorded presentations alongside live Q&A sessions and livestreamed keynote talks, the highlights of the conference were new, emerging topics.

Discussions and presentations encompassed energy materials, artificial intelligence (AI), materials discovery, sustainable processes and sustainable materials, additive manufacturing, and the future of learning, among others. In the following, I selected only a few talks that I found illustrated particularly well the future of materials research: sustainable materials, materials discovery using AI, and knowledge transmission and future of learning (and teaching).

Sustainable materials

We learned from Liangbing Hu, from the University of Maryland, USA, how to turn wood into transparent, waterproof windows to place on our rooftops to receive sunlight without the heat. At the same time, we discovered how to make Superwood®, which is lightweight wood with naturally aligned cellulose nanofibers but reduced lignin content, giving high strengths up to 600 MPa, and all this using a process similar to that in making paper. Furthermore, Hu showed that the hierarchical porosity of wood could also be harnessed for continuous ion transport, such as for continuous desalination without the problem of salt precipitation.

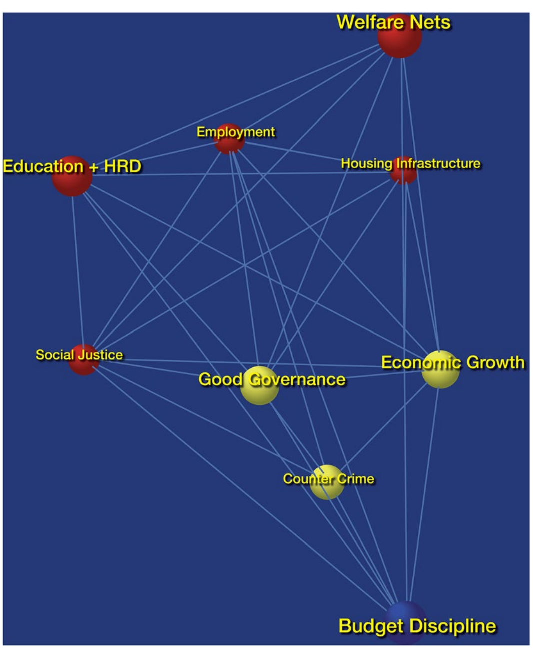

Figure 1. Constellatory map used for strategic government planning (reproduced with permission; credit: Albrecht von Müller).

Along with cellulose, chitin is the most abundant biomaterial on the planet. Audrey Moores from McGill University, Canada, showed how "simple" mechanical processes can be used to turn crustacean waste into functional materials. Combining ball-milling, aging, and weak NaOH treatment, chitin from crab shells were turned into nanochitosan molecules, with rod shapes and lengths of 182 nm, to create nanogels for bioapplications.

Materials discovery using AI

From the keynote talk by Matthias Scheffler from the Max Planck Society, Fritz Haber Institute, Germany, we learned how big data and AI can be used to find new exceptional materials by analyzing research data. The route is to find the relevant material descriptors to make maps of materials, similarly to Ashby plots. These descriptors, called "materials genes," are the basic physicochemical parameters relevant for the property of interest. Using this approach, catalysts with superior performance than currently available have been found.

Also in the search for new materials for cleaner energy, Naomi Halas from Rice University, USA, is exploring the use of abundant chemical elements from the periodic table to make more sustainable plasmonic devices, for example using AI.

Knowledge transmission and future of learning (and teaching)

Conceiving, planning, and designing the future cannot be realized without efficient teaching. Albrecht von Müller from the

Ludwig-Maximilians-Universität München, Germany, and the Parmenides Foundation introduced us to an interdisciplinary project on teaching complexity. With a team of psychologists, scientists, artists, designers, philosophers, and digital tools, they aim to conceive a new online education approach that embraces the complexity of problems. As a concrete example of an outcome of their project, they have built three-dimensional digital constellatory maps that link notions and concepts together much like a neural network. For example, one map is used for strategic government planning, networking "housing-infrastructure," "employment," "social justice," "economic growth," "education," and so on (see **Figure 1**). Being digital, one can travel inside the map by zooming in. With such a digital tool, one visualizes at the same time the overview and the details. In addition to helping our understanding of complex problems, constellatory maps also draw connections between unusual elements and can foster innovation.

As a drive for future education, the research group pinned down four game changers, which are (1) to use fascination as a motivation for learning, (2) to interplay details and overviews, (3) to use multiple disciplines to study one coherent reality, and (4) to use virtual visualization tools to help complex reasoning processes. The team also suggested that personalized learning with cognitive profiling and personalized learning paths could soon be implemented.

The Meeting chairs stated on the MH 21 website, "While the advent of COVID vaccines is a cause for cheer, it seems unlikely that international conferences will revert to business-as-usual." They aim to develop the MH series and hope to resume their long-standing International Conference on Materials for Advanced Technologies (ICMAT) series in a couple of years.

The International Conference on "Materials for Humanity" was organized by MRS-S in association with Nanyang Technological University, the National University of Singapore, and the Agency for Science, Technology and Research (A*STAR). It was sponsored by Bruker and Shimadzu (Gold), Oxford Instruments and Start (Silver), and Crystals and Sustainable Energy & Fuels (Bronze). □