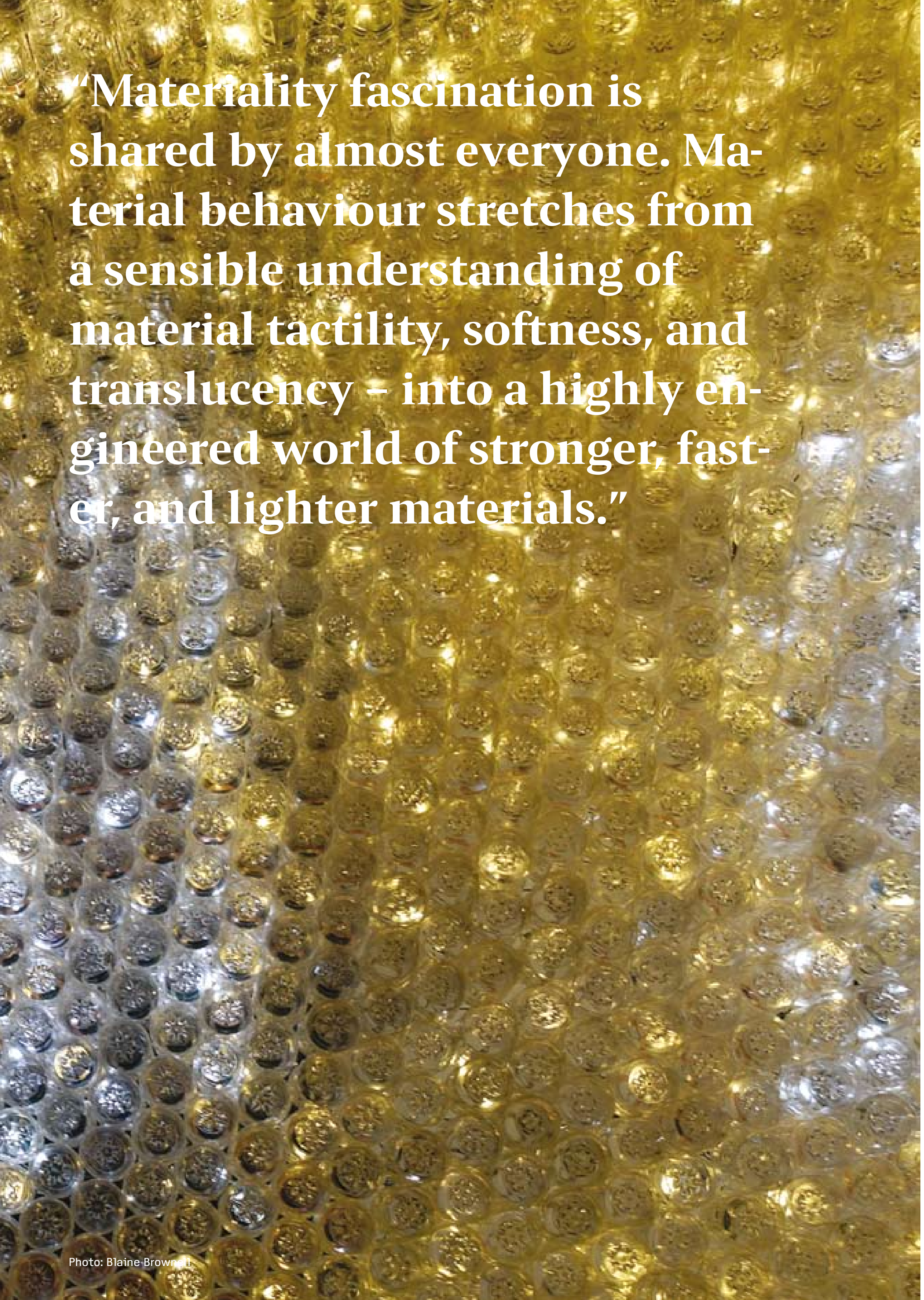

**"Materiality fascination is shared by almost everyone. Material behaviour stretches from a sensible understanding of material tactility, softness, and translucency – into a highly engineered world of stronger, faster, and lighter materials."**

Photo: Blaine Brownell

# The Colour of Today - an Interview on Material Behaviour

**Blaine Brownell**
**Founder of Transstudio, Ass. Professor University of Minnesota School of Architecture**

interviewed by
**Kasper Guldager Jørgensen, GXN**

KGJ: Materiality fascination is shared by almost everyone. Material behaviour stretches from a sensible understanding of material tactility, softness, and translucency – into a highly engineered world of stronger, faster, and lighter materials. When did you devote yourself to the world of materials?

BB: I first recognised the need to focus on materials from a direct experience in practice. I had recently completed graduate school and was working on a visible public project with the architect Mark Wamble in Houston. He asked me to research materials for this project—a task that was quite a challenge for me then, because I had no previous experience in this area. In addition, he charged me with finding the most innovative materials in terms of form and performance. Despite my struggles during that time, the endeavor was successful. As a result, I learned two very important lessons: 1) I saw firsthand how important material selection is to architecture, and 2) I realised how little architects know about advanced or high-performance materials. I concluded that a large part of this knowledge gap was a design and communications problem; thus, I began researching on a broad collection of materials in order to disseminate valuable information to architects, contractors, and clients about the most important material trends.

Materials are indeed intriguing to virtually anyone. Give adults a physical sample of a new light-bending polymer or a shape memory alloy, and they will adopt a childlike fascination. Tactile information is a powerful channel that we underutilise, and combined with our other senses becomes a powerful force. Materiality is something in which everyone may share an interest, because we are all part of the physical world, and we all have a stake in it. My goal is to capitalise on this interest in order to affect a better designed, more creatively conceived, and more environmentally-sensitive constructed environment.

KGJ: New materials are very much a matter of new scientific knowledge. The volume of research in the world of biology, physics and chemistry doubles every ten months, a rate that parallels that of the development of computing power. Where do you see this development has taken materials of today? How do you envision this will influence the materials of tomorrow?

BB: When I discuss technology in general terms, I typically show a graph of Moore's Law in order to illustrate the notion of accelerating technological ambition. I prefer to expand Moore's focus on computing power to address almost any shifting attribute of technology, such as miniaturisation, processing speed, memory capacity, etc. Stewart Brand and other Silicon Valley pundits question what will happen when the speed becomes too great; a threshold called the 'singularity'. This is certainly an interesting notion, and will affect material development. Indeed, what happens when a technological change takes one second when it used to require a month? What is the limit of human capacity for technological change? These are largely philosophical questions, but they merit our attention.

**“Give adults a physical sample of a new light-bending polymer or a shape memory alloy, and they will adopt a childlike fascination. Tactile information is a powerful channel that we underutilise, and combined with our other senses becomes a powerful force.”**

I like to consider the graph of Moore’s Law juxtaposed against M. King Hubbert’s bell curve for peak oil. I suggest that we view Hubbert’s graph in more general terms, e.g., mapping the utilisation of a limited resource over time. While these graphs come from completely different sources, their unlikely dialogue poses some interesting questions. How will accelerating technological ambition reconcile with decelerating nonrenewable resources? Will we need to shift to completely rapidly renewable resources? Or will technology experience a kind of soft landing as fossil fuels, major minerals, and fresh water supplies pass their peak capacities?

This is one of the most important interrelationships I envision for the 21st century: The balance between ambition and resources, and how we will optimise the system of flows to find the best solution for humanity and the planet.

KGJ: In architecture the word design is mainly associated with the design of buildings and objects. In materials, design is something internal. Design that touches, and sometimes changes, the very substance of a material characteristic. Can you elaborate on the potential of design in this scale?

BB: There is a lot of interest in design at the nanoscale. There is significant potential in this area, although little has influenced the building scale. However, I am working with a multidisciplinary team of researchers on what we call the ‘micron to meter’ problem. The idea is that we can utilise the benefits of nanotechnology to redesign building materials at a microscopic level, and find scalable solutions that enable us to deploy the technology for building envelopes and control systems. One idea is to create a light-transmitting skin that actively limits solar gain, harnesses solar power, stores the energy in a thin-film battery, regulates interior temperature and ventilation, and operates as an interactive digital display. Nanotechnology could bring about profound transformations like this one.

KGJ: Often we hear of smart materials. Some also call them responsive, dynamic, or even intelligent. In your definition; when can a material be characterised as such? How can this influence our built environment – any examples?

BB: Generally speaking, smart materials are those that react in a notable way to external stimuli. I suggest that we think of smart materials in terms of a range of possibilities, rather than a single definition. I propose a low threshold and a high threshold, resulting in two categories: Responsive materials (passive), and autonomic materials (active). The first category is represented by photochromic glass or ferrofluid, for example. These materials exhibit simple dynamic responses to contextual changes. The second category is more sophisticated and biomimetic, and is represented by materials like self-healing polymers that ‘bleed’ healing agents into microfissures - or ‘living glass’ windows that increase ventilation in the presence of poor indoor air quality. These technologies are not only responsive; they also seek to remediate negative environmental conditions, just as the human body would do. In reality, there is a fine line between the two categories, but I believe these thresholds help us evaluate the relative merits of smart materials.

KGJ: We refer to sustainability with a defensive logic; use less, pollute less, and even breathe less. Nature on the other hand is about growth and diversity. How can we learn from the dynamic systems in nature; can consumerism be combined with nature’s circular behaviour?

BB: In his book *Fire and Memory*, Luis Fernández-Galiano discusses endosomatic energy - the energy required for metabolic function in organisms - as having a limited possible range. Exosomatic energy, on the other hand, is energy required for processes conducted outside bodily functions, devoted to the constructed environment. Architecture, product design, and other exosomatic endeavors lack the metabolic limits of endosomatic processes; therefore finding sustainable, closed-loop cycles for those processes has proven to be especially difficult. To use a crass example, most people would not want to add fifty millimeters to their waistlines, but they would never complain about adding fifty square meters to their homes or offices. In other words, we have indicators that tell us when endosomatic processes are off balance within our body, but how about outside of our body? True conservation requires a better grasp of exosomatic balance regarding energy and resources.

We are facing an entirely new epoch with regard to material manufacturing and disposal. The existing cradle-to-grave paradigm simply has to change, and we must embrace the creative possibilities that exist within the less glamorous ‘downside’ of disposal just as we have embraced the ‘upside’ of consumption.

KGJ: If we want to mimic nature’s ecosystems, some argue that we need to re-think the way we make things. Ideally our industrial production setup should be able to adapt into a true cycle where products and materials can enter either a technical or a biological metabolism. How should we approach this – is this utopia or the way forward?

BB: First, we need to ensure that all technical nutrients are fully recyclable and that there is a fully operational infrastructure to ensure they are recycled or reused. We have no excuse using non-recyclable technical nutrients, for they only create waste; and as we have been told, waste is a design problem.

Second, we need to seek more creative, sophisticated, and balanced ways to engage the biological nutrient cycle. With fossil fuels eventually declining, many petroleum-derived materials like plastics and textiles will be replaced by renewable biocomposites. These materials will compete against biofuels, not to mention food, medicines, and other products, unless we can actively balance and manage the flow of renewable resources and healthy agriculture practices to ensure a successful closed loop.

In reality, the technical and biological nutrient cycles will overlap, and predominantly biological nutrients will ‘manage’ technical nutrients. I like the example of diatoms, which consist of soft organic tissue structured by glass skeletons - or our own bodies, in which bone is a kind of internalised ‘mineralisation’ for purposes of structural performance. Our physical environment may one day be structured in this way, with biological nutrients that manage technical nutrients.

KGJ: The increasing awareness on energy consumption has changed the focus in the building industry toward a more efficient attitude. Instead of using increasing amounts of insulation and minimising our windows we need to solve this matter in a more intelligent way. How can this be dealt with – by the use of energy harvesting materials, or in other ways?

BB: One of the most important architectural battles has been playing out within the building envelope for decades. Architects typically want more light and views, while code officials want a more hermetic separation between interior and exterior environments. Thermal performance software gives good ratings to thick building skins with minimal windows, but do we really need to distance the internalised, constructed world any more from the natural environment?

We simply need to change the rules of this debate. There are new technologies such as high-performance glass, aerogel, or transparent ceramics that vastly increase thermal performance without sacrificing light transmission. There are also glazing systems that actively reduce solar

**"Generally speaking, smart materials are those that react in a notable way to external stimuli. I suggest that we think of smart materials in terms of a range of possibilities, rather than a single definition."**

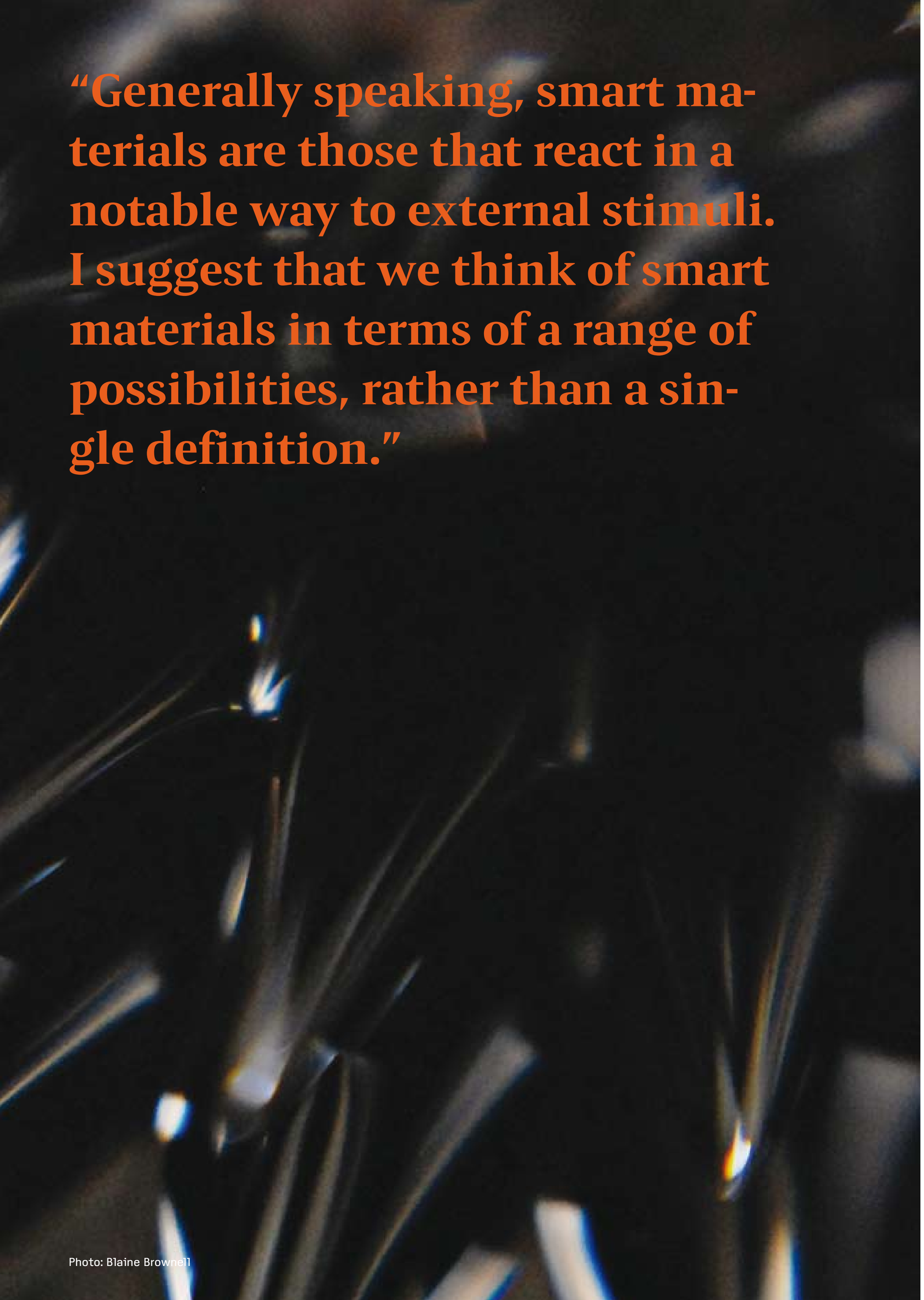

Photo: Blaine Brownell

heat gain in the summer, and heat interior spaces in winter. In addition, we should reevaluate what it is we are conditioning. The Japanese approach is to condition people, not building volume. This strategy is unusual to westerners, but in many cases it can save more energy than the hermetic building approach - especially if some of us expect to live in 600 m2 houses with every cubic centimeter conditioned at the same temperature.

KGJ: As in all disciplines topics come in and out of fashion. The current it-colour in material behaviour is in my opinion Green. Where do you foresee the next focus will be – what is the next topic to set the agenda?

BB: If green is the colour of today, tomorrow may focus on blue. Green loosely represents foliage and healthy ecosystems. Blue will represent fresh water and clear skies; which unfortunately may be much more endangered in the future. If the Amazon rain forest serves as our environmental lightning rod today, tomorrow it may be the Great Lakes.

KGJ: Admittedly this is a popular question, but I would like to end with an exemplified look in your material fascination. What is your personal top-5 on new materials?

BB: The following list includes five of the most significant material directions to watch:

1. Plastic is entering its most exciting phase since the development of Nylon and Polyester. With plastics manufacturers eyeing future decreases in petroleum, biopolymers are all the rage now. Plastics made from renewable resources have already infiltrated product packaging and food containers, and more sophisticated applications are being developed.

2. The concept of biomimicry continues to spark our imaginations, and real solutions are being synthesised that emulate natural functions and processes. Morphotex is the world's first optically coloured fiber, and mimics the wings of a butterfly.

3. The biggest word in energy technology continues to be renewables. Recent developments in photovoltaic thin-films and other renewable technologies continue to add power-harnessing capability to materials. One example is Solar Ivy, SMIT's array of photovoltaic leaves that flutter along building facades.

4. Dwindling resources push manufacturers to find creative material surrogates, and repurposed waste continues to find its way into new products as a result. Kebony is a high performance wood modified by a process called Kebonisation, in which wood properties are enhanced using bio-waste from the sugar industry.

5. Today digital fabrication is used primarily for cutting or printing elaborate forms, but 'digifab' is entering a more sophisticated era in which form and mechanical performance are tightly integrated. The MIT Media Lab's Monocoque is a structural skin that is comprised by two materials whose densities correspond to simulated loading conditions, thus, form and structure are inextricably related, and may be programmed simultaneously. ■