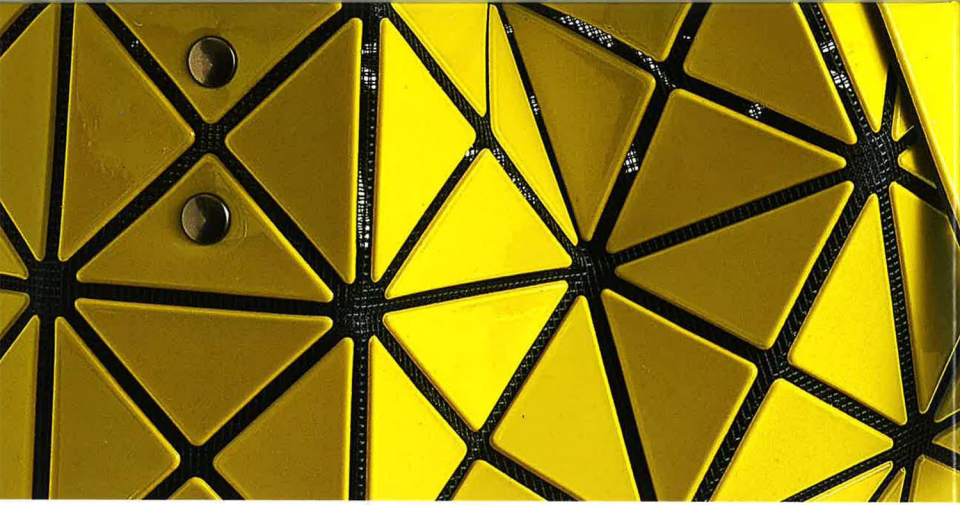
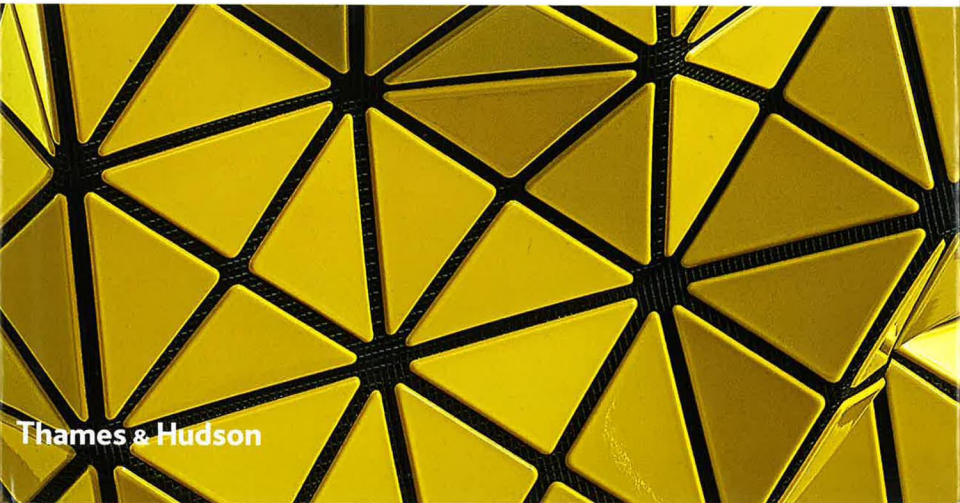


THE MATERIALS SOURCEBOOK FOR DESIGN PROFESSIONALS

ROB THOMPSON
Photographs by MARTIN THOMPSON



Thames & Hudson

ARCHITECTURE AND CONSTRUCTION

Weathering resistance
Its high resistance to ultraviolet means it maintains its colour and finish long-term, even when used outdoors.

Strength-to-weight
It is around twice the strength of glass for the same weight. Tempering improves the strength of glass, but it is still heavier than PMMA for the same strength.

Transparency
PMMA has very high light transmission and is roughly equivalent to high-quality glass. In thick sections PMMA has superior optical quality.

Colour
PMMA is available in a vast range of standard colours and finishes.

SUSTAINABILITY

PMMA is reasonably inert and does not pose any health risks as long as there is no residual monomer; MMA is allergenic. It is tasteless and certain grades are suitable for food contact.

PMMA is readily recyclable. Scrap from reliable sources, such as production facilities, can be ground and converted back into pellets suitable for molding and extrusion. Identified by code #7, 'other', it is not easily separated from mixed waste streams and so is rarely recycled end-of-life.

Chemical recycling reduces PMMA to its original monomer of MMA. In a process known as depolymerization, PMMA is heated to over 500°C (932°F) in contact with molten lead, which causes the polymer chains to break down. While this yields high-purity MMA, the use of lead has negative environmental impacts. Alternative techniques are being explored to try to overcome the reliance on lead.

PMMA IN PRODUCTS, FURNITURE AND LIGHTING

PMMA's transparency and high-quality surface are utilized in items ranging from mobile phone screens to large pieces of cast furniture and injection-molded lighting. It has high strength-to-weight and is resistant to most regular chemicals. Its only major drawback is that it is a little brittle – a result of its high stiffness combined with low elongation.

High-end and large-format phones and tablets feature aluminosilicate glass (page 522) screens. Compared to regular glass (soda-lime), this has far superior strength and stiffness. PMMA is utilized in low-end consumer products to give the illusion of glass at a fraction of the price. While they may look similar at first glance, the higher aesthetic qualities of glass – crisp surface reflections and stiffness – quickly become apparent when the screen is in use.

A key benefit of transparent plastic, compared to glass, is that it can be injection molded. Of the thermoplastics, PC and PMMA are the highest-performing structural, transparent types. The difference between them is that whereas PC has far higher impact resistance, PMMA has superior light transmission and scratch resistance. The types of application each has come to dominate illustrate these differences: PC is used to make visors, riot shields, reusable containers, front headlights and power-tool housing; and PMMA is used to make lenses, light guides, tail lights, signage and point-of-sale displays. While they are both commonly injection molded, PMMA is also frequently applied in sheet form.

Similar to other transparent materials, the edges of PMMA sheet parts glow brighter than their surroundings. This phenomenon, known as 'edge glow' or 'lit edge', is the result of light passing through the surface and refracting internally until it meets a cut edge. The same effect can be seen in scored lines (such as made by laser cutting) and is amplified through the use of fluorescent pigments. This property is utilized in signage (so the light source can be concealed), plastic optical fibre, promotional items, eye-catching packaging and point-of-sale.

A very high gloss finish can be achieved with PMMA. This is emphasized with vacuum metallizing, which adds a highly reflective aluminium coating to the surface of the plastic. Utilized in reflectors and lampshades, it is either protected on the backside of the plastic, or applied to the outside surface to give the illusion of solid metal.

PMMA IN ARCHITECTURE AND CONSTRUCTION

PMMA is used in place of glass in floors, walls, ceilings, roofs and cladding. It is used throughout interiors as furniture, lighting, signage and interactive displays. It offers many advantages compared to glass, as previously described, presenting architects with greater design freedom as well as providing benefits in application.

Frei Otto and Gunther Behnisch utilized PMMA to dramatic effect in the tensile canopy that sweeps over the Munich Olympic Stadium. Covering a large area, lightweight PMMA ensured that weight was kept to a minimum. This helped to conserve material and allowed for greater spans to be achieved. Completed in 1972, the transparent canopy remains in use to this day.

Relatively easy to process, PMMA sheet is suitable for thermoforming, laser cutting and machining. With these processes a wide range of shapes is producible at relatively low cost (an added benefit of laser cutting is that it yields a high-gloss edge finish). Glass, on the other hand, is much more challenging to produce in three-dimensional forms.

Sheets are available in a very wide range of thickness and standard colours, from transparent to opaque and fluorescent to pastel. The transparency and quality of diffusion depends on additives and surface treatments. It is laminated with film (and other sheets) to create depth or colour shift and encapsulate textile or other intriguing effects. When cast, objects may be trapped within to create floating layers or diffusing effects.

CNC-machined transparent façade
The Reiss headquarters in London features a five-storey PMMA façade. During the day, sunlight is refracted in the panel profile. At night, LED strips beneath each panel illuminate the PMMA, creating a dramatically different appearance. The façade was originally conceived as cast glass with fabric draped behind, but the architects at Squire and Partners, who designed the building, realized the limitations of this approach and sought PMMA as the alternative. Cast in very large sheets that are machined to produce a linear pattern with varying thickness, the translucent material offers a shielded glimpse of light and movement within.