



axel ritter

smart materials

in architecture, interior architecture and design

birkhäuser

DESIGN AND ART

Textiles, automobiles and furniture have to satisfy high requirements before they enter series production. However, new, innovative materials and products can sometimes be introduced more quickly in these industries than in architecture, and even more so than in the construction fields. In certain circumstances, materials and products tested in these other fields can also be modified to be used in architectural applications. It is not unusual for artists, with their sensitivity and pleasure in experimentation, to be the first to use innovative materials and products, and develop some unusual applications for them.

textile design

In earlier times textiles generally had only one or two permanent properties. Today more and more textiles with changing properties are being developed, i.e. they can change themselves in response to one or more influencing factors. This is made possible by materials and their products with inherent self-changing properties, so-called smart materials. These smart materials may be already available, newly introduced on to the market, or they may be newly developed products. They can be used on their own or in combination with non-smart or semi-smart materials.

The following section deals with textile design only in relation to clothing, as textiles used for architectural purposes are described in the main part of this book.

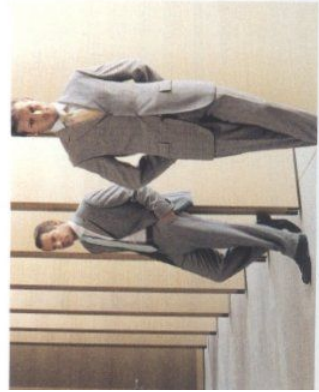
In addition to numerous experimental design projects, recent years have seen the emergence of various textile materials in functional clothing, including so-called intelligent clothing. Some examples of clothing, already available or at the prototype stage, reflecting these trends in which smart materials play a major role are described below. Some of their properties and special qualities can also be used for architectural purposes, be it in the form described here or in a different modification.

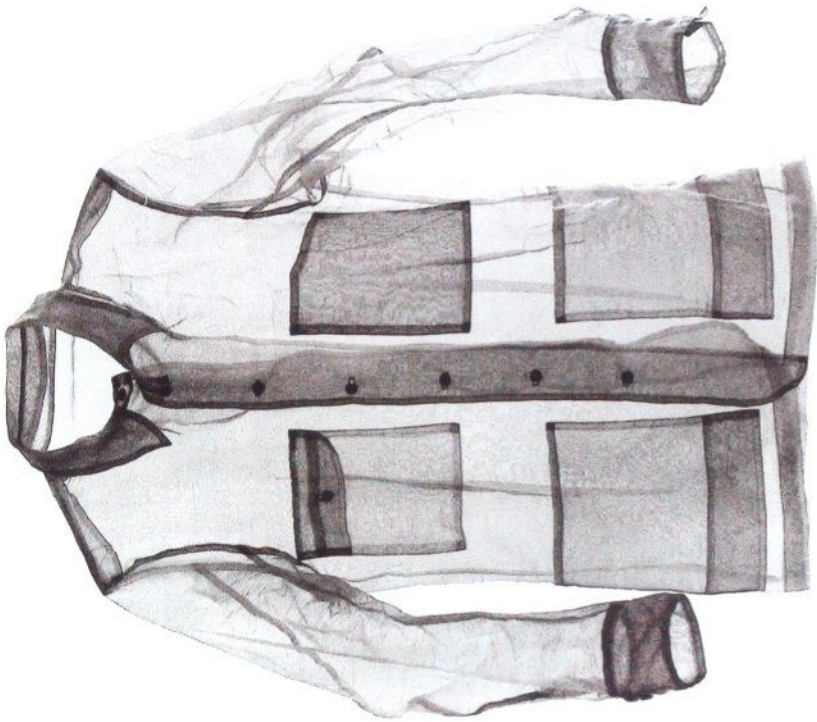
DIRT-REPELLENT CLOTHING INCORPORATING NANOPARTICLES SEMI-SMART MATERIALS

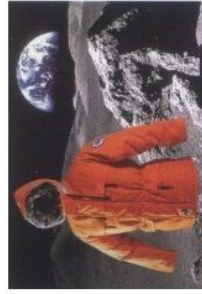
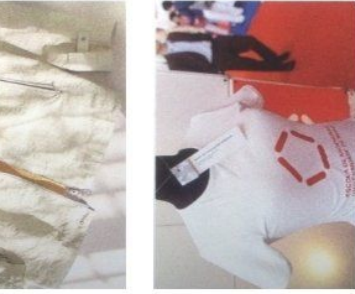
To protect suits from water or stubborn stains such as ketchup and coffee, Bugatti, a German manufacturer of high-priced men's clothing, made them from a special fabric that disposes of dirt by means of a self-cleaning effect due to incorporated nanometre-scale particles.

SHAPE-CHANGING CLOTHING INCORPORATING SHAPE-MEMORY ALLOY (SMA) SMART MATERIALS

The Italian clothing company Corpo Nove, through its spin-off firm Grado Zero Espace, manufactured a long-sleeved shirt out of a fabric incorporating a shape-memory alloy (SMA), in this case, Nitinol. Depending on how it has been preprogrammed, the fabric forms itself into different shapes in response to the ambient temperature. The shirt with the name *Oricalco* rolls up its own sleeves. When the room temperature exceeds a certain value, the fabric in the sleeves forms folds and the sleeves shorten in length. The shirt can also be compressed into its smallest possible volume, for example for transport. By allowing it to reach a preprogrammed temperature, e.g. by the introduction of warm air from a hairdryer, it regains its original shape.







SCENT-CHANGING CLOTHING INCORPORATING CYCLODEXTRINS
SEMI-SMART MATERIALS

To prevent the build-up of odour, fabrics for certain suits made by Bugatti, Germany, incorporate non-toxic naturally absorbent cyclodextrins, which take up smoke, sweat or fat in their hydrophobic hollow interiors.

SUPERINSULATIVE CLOTHING INCORPORATING AEROGEL
NON-SMART MATERIALS

For extreme cold, Corpo Nove designed the *Absolute Frontier* jacket, which uses the thermally insulative material aerogel. Developed already in 1930, aerogel is the best heat-insulative material available on the market, second only to vacuumised products. In the near future we could see clothing only 3mm thick being adequately insulative down to -50°C. Aerogel is also used in architecture, for example as a heat-insulative material between glass panes.

DEFENSIVE CLOTHING WITH ELECTRON-EMITTING TEXTILES AND LEDS
SMART MATERIALS

The *No-Contact* jacket designed by the US-American company of the same name is intended to defend the wearer against attack. Primarily marketed for the protection of women, the wearer first activates the jacket with a key. An LED lets the wearer know this has been done. In the event of an attack, the wearer presses a control button in either of the sleeves to release a pulsating electrical current of low amperage but at a voltage of 80,000 volts, which flows through the surface of the jacket. The jacket creates visual and audible electric arcs between the shoulders and collar to warn off an approaching attacker.

COMMUNICATING CLOTHING WITH INTEGRATED MP3 PLAYER
SEMI-SMART MATERIALS

A jacket with an integrated MP3 player has been developed by Infineon in conjunction with system partners. This is an example of so-called wearable electronics. Earlier electronic components could not be fully integrated into clothing because they would be rendered non-functional by washing. Here the company developed a solution in which all four components (audio-chip, power module, microphone and controls) of the system were fully encapsulated to protect them against moisture, and had high-quality, adequately resistant seals. Fine wires were woven into the fabric to transfer the electrical signals. The power was supplied at first from lithium-ion polymer rechargeable batteries, which in the later series production phase would be replaced by thermogenerator chips (see thermoelectric generators (TEG), pp.148ff.). These chips would generate an electric current with an output of more than 1.0µW/cm and a voltage of 5 V/cm from the small temperature difference between skin and clothing. In most cases this is adequate for low power components such as sensors and microchips. However, up to now no products incorporating thermogenerator chips have been brought on to the market.