

## One wipe and it's clean

### In the future, the surface materials used for vehicle interiors will be both aesthetic and practical



Every time a new model is developed, engineers and technicians join forces with stylists to pursue one main aim - beauty, right down to the last detail. The shapes and colours used in the vehicle interior must match the body, convey aesthetic appeal and reflect the current fashions and trends. As a manufacturer of exclusive vehicles, the BMW Group goes one step further when designing superior interior materials: it ensures that the surfaces are not only delightful to look at, but also equally pleasant to hear and touch. BMW researchers are therefore developing low-noise, pleasant-feeling and, moreover, dirt-resistant materials for use in future generations of vehicles.

According to an old American proverb, "Seeing is believing, touching is knowing". In actual fact, the human sense of touch is especially important when a new product is encountered because every product is initially "experienced" via the sense of touch, and it is on this basis that the quality of the product is evaluated. The scientific community refers to the sense of touch as "haptics" and subsumes everything relating to the sense of touch under the terms of "tactile" and "haptic". Today, these terms are also applied to materials and the investigation of how an object is to feel, grip and touch, as well as the physical material properties that are responsible for specific haptics. This is often a difficult undertaking, because several properties generally have an effect at the same time.

A small team of researchers within the BMW Group has been successful in uniting aesthetic appeal and practicality in the vehicle interior for the benefit of its customers, thereby filling a niche with its innovations and enabling the company to distinguish itself, once again, from other manufacturers. Yet the visual appeal of high quality interior materials is not the only criterion. They must also demonstrate functionality and thus enhance the overall perfection of the vehicle. Drivers should enjoy 'touching' every aspect of the interior, from the seats, through the steering wheel and the gear stick to the tiniest button on the dashboard.

### Researcher love the second time around

The methodical design of materials and surfaces that incorporate haptic and dirt-resistant properties is one example of synergetic effects in BMW's research activities. When vehicle interior noise became a topic of discussion around five years ago, the engineers applied themselves to the task of eliminating it (see ScienceClub article "Researchers seek contacts", 10th April 2003). The challenge: although the engineers had managed to eliminate background noise from the engine in the vehicle interior, other noises which had been previously masked by engine and driving noises appeared and, although they were not loud, they were perceived as annoying.

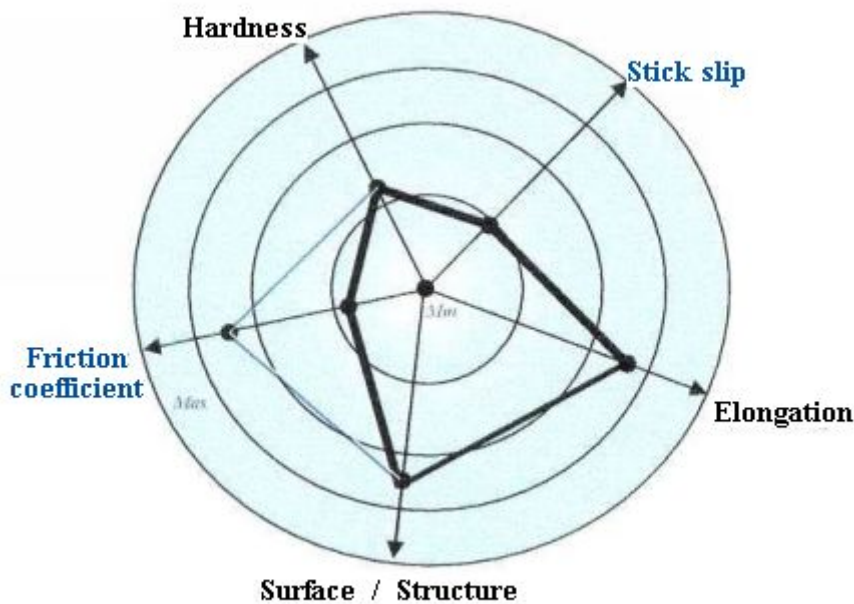


Initial research on the elimination of unwanted noise involved a thorough and detailed analysis background noise in the vehicle interior. In recent years, the noise specialists in Munich have developed a comprehensive range of instruments, measuring procedures and equipment to enable detailed diagnosis and analysis of background noise. One positive side effect of this complex search for sounds and noises is that the measuring instruments and software tools developed for this purpose have also proven suitable for testing the surface properties of materials used in vehicle interiors. "Through our work to solve noise problems, we incidentally developed effective instruments that are suitable for investigating the haptic and other properties of surfaces," said Klaus Steinberg, Background Noise Acoustics Team Leader at the BMW Group.

"This has extremely exciting potential because haptics is a field of vehicle interior development that is characterised by very subjective perceptions," said Steinberg. The sense of touch is especially significant for our assessment of the environment, because it is one of the oldest senses that we possess. Before we take a close "look" at and "listen to" our environment, we can already "feel" it. The sense of touch is our skin's "sensor" and it provides us with information about how we feel and about whether the environment that we are in is welcoming or hostile. It has many different capabilities: it is able to perceive three-dimensional objects and simultaneously absorb information about the object's surface structure, hardness, temperature and other properties. No other perceptive faculty provides more information directly to our subconscious minds than the sense of touch.

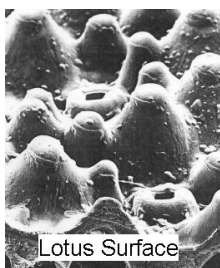
## Creating an objective basis for the perception of materials

This is why product designers have tried to discover the aspects of the vehicle that appeal to the sense of touch: e.g. slightly rough and warm surfaces, low friction coefficients, materials that transport a great deal of moisture and product profiles that only require a low level of force to touch. In the past, the choice of the specific material properties and the adaptation of the materials use in vehicles was exclusively the task of style specialists. These "feel good" experts have to rely on their own instincts. Their perceptions - also subconscious perceptions - are the basis for the decision on which materials will be used. This is often an arduous task, particularly when they only need to change the smallest of details. "A steering wheel that has too much 'grip' or is too smooth would subconsciously annoy the driver, and the engineers who select materials in accordance with surface properties may not be able to perceive this fine difference," said Steinberg.



Within the scope of its most recent surface research activities, the BMW Group has now developed a special measuring catalogue that will help it to define and develop surfaces with outstanding haptic properties in the future. It will serve as a classification tool for the measurement, analysis, categorisation and optimisation of surfaces. The measuring criteria include, for instance, friction force at defined contact pressure, compression deformation and surface structure - roughness, for example. Yet it also covers aspects such as heat conduction, stretching deformation and flexural strength. The ability to measure these surface properties enables the creation of models that put the various measured values in relation to one another. If a value is changed to optimise a surface, for example the hardness of leather, the model demonstrates the ensuing effects on other factors such as stretching, structure and friction coefficient. The BMW Group is also working on the further development of the measuring catalogue in conjunction with specialist organisations, such as the only leather institute in Europe, the FILK Institute in Freiberg, Saxony.

### Lotus in leather

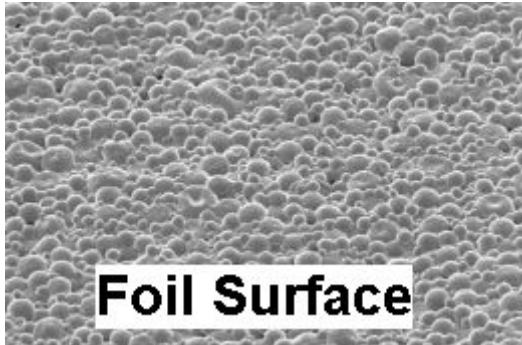


Lotus Surface

The grip experts at the BMW Group recently celebrated a minor breakthrough by applying the 'lotus effect' to leather-like foil materials. This effect was named after the lotus flower, which is worshiped in Asia as a holy flower. The lotus is held in such high esteem because of its beauty and because of another property that it demonstrates: it is always perfectly clean because all dirt is washed away the next time it rains. Even highly adhesive substances are washed away by the water and not even glue can adhere to its surface. Following the example of this fascinating flower, the BMW researchers attempted to find the ideal surface for the leather-like components in the vehicle interior. These are generally

coated to make them more durable. Yet when coated with conventional foil materials, the leather still has distinct crevices in which dirt can collect. BMW joined forces with partners in the chemicals industry to develop a new foil that demonstrates a smooth surface structure as a result of changing its adhesion properties. The foil is produced on the basis of water and is thus an environmentally friendly coating that is applied to the surfaces with the assistance of sophisticated rolling technology.

**Dirt: now you see it, now you don't**



Series tools and materials have now been used to manufacture the first parts, such as front-seat back covers and door panels, in the new foil. The invisible coating performed extremely well in various tests. "For example, very pale front-seat back covers are very sensitive and, depending on intensity of use, can show signs of wear and tear. Although marks made by shoes have always been difficult to remove in the past, the new foil coating enabled their removal in one wipe," explained Klaus Steinberg. One thing particularly impressed the researchers: in one test, the new surface coating influenced the original surface grain to such an extent that even a Post-it note didn't adhere to the door panel. In

contrast, it adhered very well to a conventionally coated door panel.

Car owners who dream about a permanently pristine car will have to dream on for a while, because lotus surfaces are generally slightly matt, which means that shiny sheet metal still has to be polished by hand