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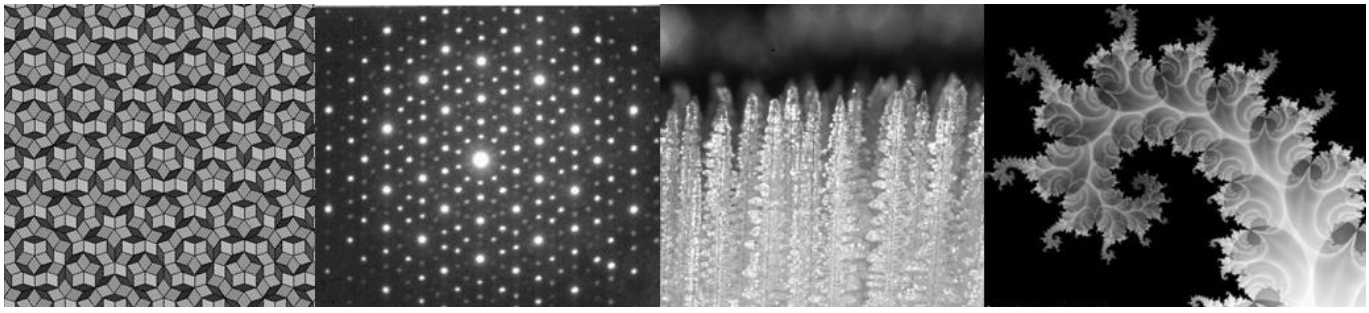
Technology Step Change

Technology Strategy Consultants (***tsc***) aim to promote thinking and innovation within the aluminium industry.

During the course of our research we often encounter items of interest to the world of semi-fabricated aluminium products which, on their own, may seem insignificant but, when added together, could be seen as a step-change in their field of technology.



"Natural" Aluminium for Architectural Applications

Have you ever wondered why some materials used on the outside of buildings, such as stone, brick or wood, are allowed to be very irregular in appearance, while others, such as concrete, paint or aluminium, have to be perfectly uniform? You could argue that the difference is one of old traditional materials against modern ones. But what about copper? Copper passes through a range of non-uniform brown colours to green as it weathers naturally. The Romans were using concrete long before copper cladding was invented, and yet concrete is required to be uniform, whereas the "natural" appearance of copper is deemed aesthetically desirable.

Architects are fond of talking about the "natural" appearance of materials. Paint can be applied to most substrates to mask their natural appearance. Paint is not a "natural" material, and it gives good uniformity. Why can anodized aluminium not be seen as "natural"? After all, anodizing is transparent, so the metallic surface of aluminium, with all its "natural" non-uniformities is revealed.

Exploiting the metallic qualities of aluminium

Currently, aluminium extrusions or sheet are either etched in a sodium hydroxide-based solution or brightened in a phosphoric acid-based solution before anodizing. These remove pick-up and die lines, which look too geometric to be natural.

Aluminium-clad Imperial War Museum North

Etching then leaves a sparkly, satin appearance that produces an appealing range of angle-dependent reflections on the side of a building. Architects say aluminium is lively in appearance, in contrast to the flat appearance of paint. Quite uniquely, the bright surface of aluminium may be preserved by subsequent anodizing.

The etching and brightening responses of aluminium depend heavily on the composition and microstructure of the alloy. Consequently, it is very difficult to achieve excellent uniformity from profile to profile or sheet to sheet. Variations from brick to brick or stone to stone are not noticeable because the variations within a single brick or stone are random and of a comparable dimension - one that is visible at the normal viewing distance.

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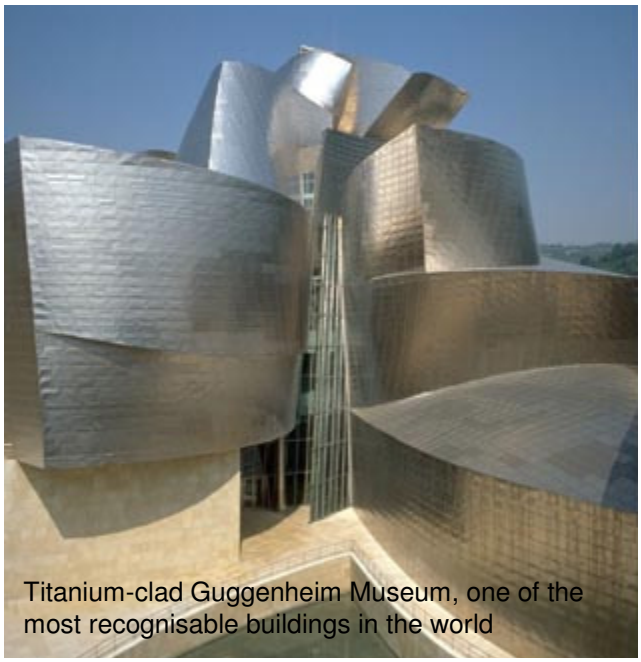
Reducing uniformity?

With much effort, the aluminium industry has achieved good etch and brightening uniformity on a single profile or sheet. However, perhaps we should actually be concentrating on achieving poor uniformity, ideally random and on a scale of several centimetres. Just look at the Guggenheim Museum for an example of this.

So who could do it? The anodizers and fabricators are too small to be able to take on this innovation. Perhaps there are organizations in other industry sectors that already operate processes that could help. Otherwise, innovation would have to come from the aluminium mills and extruders.



Titanium-clad Guggenheim Museum, one of the most recognisable buildings in the world

So how would you do it?

We want to retain etched or brightened surfaces or something similar because they look metallic. As the chemical processes depend on microstructure, controlled variation in metallurgy could provide a route for modification. Of course there are other methods of texturing that are not chemical, such as linishing and shot blasting, which are well established. It makes you wonder whether we could randomly emboss a surface using scrap-booking technology.

Also, the texturing should be random. That suggests a software-driven process, which could be programmed so that no two surfaces are identical. Methods involving scanning a light beam across the surface come to mind. Printing technology could be useful; perhaps there is scope to learn from lithographic plate manufacturers. Perhaps we could think of other ways of controlling the wetting of an aluminium surface by adapting existing processes. After all, the texturing should be on a relatively large scale. Although there could be sufficient value in the product to make off-line processing of cut sheet worthwhile, it would still be desirable to carry out the texturing process soon after the mill.

As for the anodizing, all that is needed is a bare, clean aluminium surface. Then the protective film can be readily grown using established methods to preserve the randomly textured surface. This would avoid all the current special procedures in metal composition, casting, rolling, extrusion, ageing and product control that are necessary to satisfy architects and get the prestige projects for aluminium.

It makes you think, doesn't it?

This "what if" scenario has been brought to you by ***tsc,*** to help relieve us of the here and now, and promote thinking and innovation within the industry.

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