

# Nanotechnology and innovation in vehicle manufacture

Nanotechnology refers to the production and application of materials at an atomic or molecular scale. While the concept of manipulating materials at an infinitesimal scale was formulated in the 1950s, it was only in the early 2000s that these scientific forays gained a foothold in commercial manufacture. Today, over 600 nanotechnology-dependent products are available as consumer products, with an estimated rate of three to four new products being developed each week.

Yet despite having delivered many breakthroughs in mainstream manufacture and industrial design, we're only just beginning to see the technology's true potential when it comes to the vehicle industry.

## Why is nanotechnology so significant to the vehicle industry?

Vehicles present a number of interesting engineering challenges.

They need to be lightweight enough to permit rapid acceleration but also need to be strong enough to withstand those forces. Engines require materials which afford a combination of durability and flexibility. There's also the aesthetically-driven demand for materials which are both pleasing to the eye and durable to constant pressures of driving and human contact.

For the vast majority of the history of car design, the story of innovation revolved almost solely around finding better solutions for these engineering conundra.

Then the potential of nanotechnology came to light. Stronger, lighter and more durable than conventionally produced materials, nanomaterials are uniquely

positioned to meet the rigor and complexity which advanced vehicle design demands.

Let's take a quick guided tour through some of the more exciting leaps neurotechnology is making possible in car design.

## Improved engine efficiency and durability

### Nanomaterials

It's probably a fairly self-evident statement, but car engines undergo huge stresses. They need to operate at high temperatures and to withstand constant friction and motion. Nanomaterials can be used to find new ways to deal with these operational constraints. For example, they can be used to fundamentally alter aluminum. Whereas regular aluminum is far too brittle to be used inside an engine, nano-aluminum can be engineered to be more durable and flexible, while still retaining its lightweight properties.

### Nanofluids and nanocoating

New kinds of fluids are also being developed to improve on conventional fluids, such as lubricant. Nanofluids offer new ways to enhance lubrication by permitting far greater control over particle shape, size and concentration (three vital determinants affecting wear and friction in a vehicle). For example, copper and gold nanoparticles show great promise in developing a liquid protective film which can enhance conventional oil-based lubricants.

Nanocoatings also show great promise as a way to improve engine efficiency. Protective outer layers for engine components are being developed which are made up of nanoparticles of ceramic. Taking advantage of ceramic's unique thermal and friction properties, this new material offers extraordinary potential as a means of reducing abrasion and wear within the engine.

Engines in the future won't just be constructed of lighter and stronger nanometals, they'll also be enhanced through uniquely heat, wear and friction-resistant nanomaterials. The end result will be greatly improved engine efficiency and durability.

## Safer and more efficient fuels

### Hydrogen fuel cells

As fossil fuel powered cars continue their journey to obsolescence, new fuel alternatives are now receiving considerable attention. Relatively inexpensive and highly efficient, fuel cell technology is one possibility with considerable market potential.

Because fuel cells are hydrogen-dependent, research has gone into new materials capable of enhanced hydrogen storage and delivery. Nanotechnology offers a novel solution of storing hydrogen in a semi-solid state. The method involves solid-phase storage of hydrogen using carbon nanomaterials. Carbon nanotubes are exceptionally useful as a porous substrate for hydrogen storage. While more research is required, nanotechnology looks set to provide new methods of safe, inexpensive hydrogen fuel cell powered vehicles.

### Battery enhancement

Nanotechnology can also enhance the cathode materials within batteries, greatly increasing their efficiency. For example, nanoparticles of silicon may be used to create a new generation of lithium silicon batteries. Not only would such batteries provide an order of magnitude improvement in their capacitance, they'd also be cheaper and less environmentally harmful to produce.

## Cars which look better for longer

### Automotive coating

Conventional outer clearcoat automotive paint layers are among the most vulnerable aspects of a car's aesthetic elements, particularly if exposed to harsh environmental conditions. As such, there's a strong market for materials which maintain the paint layer's luster for as long as possible.

Nanosized inorganic fillers can be employed to create a finish that is exceptionally smooth. The small particle size and resulting huge surface area create an outer coat which is both extremely hard and highly elastic. These nanoparticle coatings also exhibit the desirable property of being almost completely transparent. The end result is a surface which is both optimized for a high shine finish and intrinsically scratch resistant. A win-win!

## Interior fabrics

Consumers don't just expect high performance from vehicles on the market, they're also looking for interior fabrics and textiles which are both comfortable and pleasing to look at not just one week after purchase but throughout the car's operational lifetime. This is no small challenge!

Through nanotechnology, new textiles are being produced which aren't just anti-bacterial and self cleaning, they're also fire retardant and highly durable. For example, using nanotechnology, anti-microbial and odor resistant agents such as silver and titanium oxide can be embedded directly into fabrics. The result is a non toxic, durable fabric which is capable of oxidizing microorganisms on a permanent basis.

Given its wide variety of applications, nanotechnology looks set to transform vehicle manufacture. The novel properties of nanoscale materials won't just give us new ways to answer those ever-present engineering challenges of improved engine efficiency and better fuel sources. It'll also open up the possibility of cleaner, more durable and just plain prettier aesthetic elements! It'll be exciting to see what cars look like when all these technologies come to fruition.