# Blended structure makes steel light yet sturdy

**Material bests titanium alloy for strength and ductility.**

**Boer Deng**

04 February 2015 | Corrected: 06 February 2015

Imaginechina/Corbis

A recipe for lighter, stronger steel adds nickel to an alloy of iron, carbon, aluminium and manganese.

The price of petrol may have fallen, but car makers are still keen to improve fuel efficiency. Building vehicles with lighter materials is one approach: trimming a car's weight by one-tenth can boost fuel economy by 6–8%. But steel remains the preferred construction material for cars — other metals are costlier and harder to work with. The challenge is to find a light, strong, ductile steel alloy, often made by exchanging some of the iron for aluminium and other elements.

In the 5 February issue of *Nature,* materials scientist Sang-Heon Kim and colleagues at Pohang University of Science and Technology in South Korea describe[1] improving lightweight steel by altering how metal compounds are arrayed in an alloy. They report that the microstructure of their material is stronger and more pliable than even titanium alloys.

Close study of metallic microstructures has a long history, beginning, appropriately, in Sheffield, England, the steel-producing city where geologist Henry Clifton Sorby first took a microscope to manufactured steel in 1863. Since then, much has been learned about its physical properties.When heated sufficiently, steel's atoms arrange into a form known as austenite. That structure lends ductility to steel, which makes it useful for shaping into parts. Adjusting the makeup of the alloy can lower the temperature at which austenite is stable by hundreds of degrees Celsius.

**Strong and supple**

Another possible structure in steel is B2 — a hard, brittle cube formation. Iron and aluminium tend to form B2 structures in steel alloys, but usually, materials scientists try to prevent this by adjusting the temperature or adding other elements.

Kim and his colleagues made a steel that takes advantage of B2's hardness and austenite's ductility. By adding nickel and temperature-treating an alloy of iron, aluminium, manganese and carbon, they induced smatterings of B2 to form evenly throughout the steel. The resulting material, in which the hard B2 lattices reinforce the supple austenite matrix, has impressive tensile strength.

The researchers think that their work could be useful for industrial steel making. But "even if it takes a long time before this can become a part of production, the novelty of the microstructure that forms could be very useful for thinking about how to construct new alloys", says Suveen Mathaudhu, a materials engineer at the University of California, Riverside.

Hansoo Kim, one of the paper's co-authors, says that he and his colleagues will work with South Korean company POSCO, one of the world's largest steel manufacturers, to scale up their methods. The iron mills of Sheffield and Pittsburgh, Pennsylvania, have long since quieted, but that is far from the case in South Korea: buoyed by its car industry, steel production there has grown nearly 50% since 2005.

*Nature* | doi:10.1038/nature.2015.16849

## Corrections

**Corrected:** This article incorrectly gave one of the components of the steel as magnesium instead of manganese. The text has now been corrected.

## References

1. Kim, S.-H., Kim, H. & Kim, N. J. *Nature* **518**, 77–79 (2015).