AN 18-CARAT GOLD NUGGET MADE OF PLASTIC

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The creation of a new type of gold is considered in this paper. The properties of this new gold form are outlined.

Lovers of gold watches and heavy jewellery will be thrilled. The objects of their desire may someday become much lighter, but without losing any of their glitter. Especially with watches, a small amount of weight can make all the difference. No one wants to wear a heavy watch on their wrist, even if it's made of real gold. After a time, it becomes uncomfortable and annoying.

Professor of Food and Soft Materials, Leonie van't Hag set to create a new form of gold that weighs about five to ten times less than the traditional 18-carat gold. A typical mixture usually consists of three quarters of gold and one quarter of copper with a density of about 15 g / cm3. That's not true for this new lightweight gold: its density is just 1.7 g/cm3. ,And nonetheless it is still 18-carat gold.

A nugget of real 18 carats gold, so light that it does not sink in a cappuccino, floating instead on the milk foam – what sounds unbelievable has actually been accomplished by researchers from ETH Zurich. Scientists led by Raffaele Mezzenga, Professor of Food and Soft Materials, have produced a new kind of foam out of gold, a three-dimensional mesh of gold that consists mostly of pores. It is the lightest gold nugget ever created. "The so-called aerogel is a thousand times lighter than conventional gold alloys. It is lighter than water and almost as light as air," says Mezzenga.

The new gold form can hardly be differentiated from conventional gold with the naked eye – the aerogel even has a metallic shine. But in contrast to its conventional form, it is soft and malleable by hand. It consists of 98 parts air and only two parts of solid material. Of this solid material, more than four-fifths are gold and less than one-fifth is milk protein fibrils.

Instead of a metal alloy element, van 't Hag, Mezzenga and colleagues used protein fibres and a polymer latex to form a matrix in which they embedded thin discs of gold nanocrystals. In addition, the lightweight gold contains countless tiny air pockets invisible to the eye.

First, they added the ingredients to water and created a dispersion. After adding salt to turn the dispersion into a gel, next they replaced the water in it with alcohol. Then, they placed the alcohol gel into a pressure chamber, where high pressures and a supercritical CO2 atmosphere enabled miscibility of the alcohol and the CO2 gas; when the pressure was released, everything turned it into a homogeneous gossamer-like aerogel. Heat was further applied afterwards to anneal the plastic polymers, thus transforming the material and compacting into the final desired shape, yet preserving the 18-carat composition.

This gold has the material properties of a plastic. If a piece of it falls onto a hard surface, it sounds like plastic. But it glimmers like metallic gold, and can be polished and worked into the desired form. The researchers can even adjust the hardness of the material by changing the composition of the gold. They can also replace the latex in the matrix with other plastics, such as polypropylene. Since polypropylene liquefies at some specific temperature, "plastic gold" made with it can mimic the gold melting process, yet at much lower temperatures. Furthermore, the shape of the gold nanoparticle can change the material's colour: "nanoplatelets" produce gold's typical shimmer, while spherical nanoparticles of gold lend the material a violet hue.

The optical properties of gold depend strongly on the size and shape of the gold particles, Therefore we can even change the colour of the material. When we change the reaction conditions in order that the gold doesn't crystallise into microparticles but rather smaller nanoparticles, it results in a dark-red gold. By this means, the scientists can influence not only the colour, but also other optical properties such as absorption and reflection.

Mezzenga points out that, while the plastic gold will be in particular demand in the manufacture of watches and jewellery, it is also suitable for chemical catalysis, electronics applications or radiation shielding. The researchers have applied for patents for both the process and the material.

References:

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