

New nanotube material stays rubbery over a more than 1,000 degree temperature range

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Flexible carbon nanotube material. Scale bar is 1mm. Image credi: Science, DOI:10.1126/science.1194865

(PhysOrg.com) -- Silicone rubber is used in many applications in which a material is required to remain rubbery over a wide temperature range, since it retains its properties over the approximate range of -55°C to 300°C . Now a new material made of carbon nanotubes has been developed that retains its viscoelastic properties over a temperature range almost four times larger.

Scientists at the National Institute of Advanced Industrial Science and Technology (AIST) in Tsukuba, Japan created the nanotube material using chemical vapor deposition. The material has elastic properties of recoverable stretchiness, and viscoelastic properties that give it a thick-honey-like consistency, and allows it to stretch slowly and then spring

back to its original shape. It retains these properties over the range of -196°C to 1000°C.

The research team, led by Dr. Ming Xu, has previously worked on [carbon nanotube](#) “forests,” and development of the new material was the accidental product of an extension of this work. In the “forest” the long nanotubes grow upwards, but when the team modified the catalysts used in the process they found they could make the alignment of the nanotubes much less regular, and were able to create a random network of interconnected nanotubes, which Xu likened to a tangle of jungle vines.

They then investigated the properties of the new material and discovered it has similar viscoelastic properties to silicone rubber at room [temperature](#), but unlike [silicone](#) rubber, which becomes brittle when cold and breaks down at high temperatures, the new [rubber](#) material remained flexible over a much larger temperature range and has excellent fatigue resistance properties. The researchers speculated the thermal stability could arise from energy dissipating as the carbon nanotubes zip and unzip at points of contact.

Until now, very little research has been done on the viscoelastic properties of carbon nanotubes, probably because they are difficult to make and because they oxidize readily at high temperatures. Xu said the research team is now looking for industrial applications for the new material, so they can further refine its properties to suit those applications. She also said she believed the temperature range could be extended much further, and the material could probably be made more elastic, stronger or softer, as required.

The material may find uses in space applications or rubbers for use in extremely hot environments, but the research is still at an early stage. The findings on the new material are published in *Science*.

More information: Carbon Nanotubes with Temperature-Invariant Viscoelasticity from -196° to 1000°C , Ming Xu et al., *Science*, Vol. 330 no. 6009 pp. 1364-1368. [DOI:10.1126/science.1194865](https://doi.org/10.1126/science.1194865)

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