Nanomechanical energy storage in twisted nanotube ropes

The research was published recently in the journal Nature Nanotechnology ("Giant nanomechanical energy storage capacity in twisted single-walled carbon nanotube ropes"). Sanjeev Kumar Ujjain, from CAST, was a lead researcher on the work. He started the project while at Shinshu University, in Nagano, Japan, and continued after arriving at UMBC ...

Although nanomechanical energy storage in ultralong triple-walled CNTs 8, multiwalled (MW) CNT fibres 7, 18, MWCNT/graphene composites 19 and MWCNT ropes has been previously studied, the degree to which CNT systems may be competitive with alternative energy storage media remains unclear.

More information: Shigenori Utsumi et al, Giant nanomechanical energy storage capacity in twisted single-walled carbon nanotube ropes, Nature Nanotechnology (2024). DOI: 10.1038/s41565-024-01645-x

Notably, the gravimetric energy density of these twisted ropes reaches up to 2.1 MJ kg -1, exceeding the energy storage capacity of mechanical steel springs by over four orders of magnitude and surpassing advanced lithium-ion batteries by a factor of three.

In contrast to chemical and electrochemical energy carriers, the nanomechanical energy stored in a twisted SWCNT rope is safe even in hostile environments. This energy does not deplete over time and is accessible at temperatures ranging from -60 to +100 °C.

The calculated reversible nanomechanical energy storage capacity of carbon nanotube ropes surpasses that of advanced Li-ion batteries by up to a factor of ten. Discover the world"s research 25 ...

We present a rational and general method to fabricate a high-densely packed and aligned single-walled carbon-nanotube (SWNT) material by using the zipping effect of liquids to draw tubes together.

Unlike a bundle of carbon fibres consisting of irregular graphitic nanoribbons that store energy during stretching, four different channels store energy in a twisted SWCNT rope 15, 16, 17. When the rope is twisted, each strand is subjected to stretching, twisting, compression and bending.

Giant nanomechanical energy storage capacity in twisted single-walled carbon nanotube ropes Shigenori Utsumi 1,8, Sanjeev Kumar Ujjain 2,3,8, Satoshi Takahashi 1, Ryo Shimodomae 1, Tae Yamaura 1, Ryosuke Okuda 1, Ryuichiro Kobayashi 1, Oga Takahashi 1, Satoshi Miyazono 1, Naoki Kato 1, Keiichi Aburamoto 1,

Giant nanomechanical energy storage capacity in twisted single-walled carbon nanotube ropes. ... nanotubes and reveals phase transitions that show an extreme sensitivity to nanotube diameter, with ...

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single-walled carbon nanotube ropes, Nature Nanotechnology (2024). DOI: 10.1038/s41565-024-01645-x ...

The deformation energy of twisted nanotube ropes contains contributions associated not only with twisting but also with stretching, bending, and compression of individual nanotubes. We quantify these energy contributions and show that their relative role ...

Giant nanomechanical energy storage capacity in twisted single-walled carbon nanotube ropes Posted by Dan Breeden in categories: energy, nanotechnology A single-walled carbon nanotube spring stores three times more mechanical energy than a lithium-ion battery, while offering wide temperature stability and posing no explosion risk.

A sustainable society requires high-energy storage devices characterized by lightness, compactness, a long life and superior safety, surpassing current battery and supercapacitor technologies. Single-walled carbon nanotubes (SWCNTs), which typically exhibit great toughness, have emerged as promising candidates for innovative energy storage solutions. Here we ...

Here we produced SWCNT ropes wrapped in thermoplastic polyurethane elastomers, and demonstrated experimentally that a twisted rope composed of these SWCNTs possesses the remarkable ability to reversibly store nanomechanical energy.

chemical and electrochemical energy carriers, the nanomechanical energy stored in a twisted SWCNT rope is safe even in hostile environments. This energy does not deplete over time and is accessible at temperatures ranging from -60 to +100 °C. Single-walled carbon nanotubes (SWCNTs) offer unique possibilities to produce high-performance ...

We find that a twisted nanotube rope may reversibly store energy by twisting, stretching, bending, and compressing constituent nanotubes. We find that in the elastic regime, the interior of a ...

Unlike the variable performance that lithium-ion batteries deliver under different operating temperatures, the twisted carbon nanotubes demonstrated consistency in energy storage through a wide ...

A PRESS RELEASE on "Giant Nanomechanical Energy Storage Capacity in Twisted Single-Walled Carbon Nanotube Ropes" published on Nature Nanotech (April, 2024). LINK. A press release about "Giant nanomechanical energy storage capacity in twisted single-walled carbon nanotube ropes" was posted in Shinano mainichi shinbun (and other news ...

Giant nanomechanical energy storage capacity in twisted single-walled carbon nanotube ropes ... Z. G., Seifert, G. & Tománek, D. Nanomechanical energy storage in twisted nanotube ropes. Phys. Rev ...

Deformations and nanomechanical energy storage in twisted car-bon nanotube ropes1 DAVID TOMANEK,

Nanomechanical energy storage in twisted nanotube ropes

ZACHARIAS G. FTHENAKIS, Michigan State University, GOTTHARD SEIFERT, DAVID TEICH, TU Dresden -- We determine the deformation energetics and energy density of twisted carbon nanotube ropes that effectively constitute a torsional spring. Due to the ...

To demonstrate the application and energy conversion efficiency of the stored mechanical energy in the twisted rope samples, we rotated a circular disc 8 × 10 3 times heavier than that of the y-rope (TPU) using the energy stored in the twisted ropes.