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CNT Infused Carbon FIber in Bicycles [1]


[2]

Professional cycling is an area where every gram matters. Many high-end manufacturers are beginning to go beyond simple carbon fiber [3] bike frames and incorporating Carbon Nanotubes [4] (CNT [5]) into their carbon fiber [3] resin. Bike makers like Bianchi and BMC as well as component manufacturers like Easton are designing state of the art bicycles that are lighter and stronger than conventional carbon fiber [3] by 20-30%[1]. Some of these CNT [5] bike frames weigh as little as 860 grams?less than 2 pounds?with increased rigidity and fracture resistance[2].

This reduced weight, increased strength, and overall better performance does not come without a price. The going rate for these top shelf frames is around $4,000-$5,000 with complete bikes costing upwards of $14,000 before any customization. Additionally, these bikes have limited warranties. Although CNTs [6] are stronger than steel, the frames are relatively sensitive to chips, micro fractures and crushing at angles perpendicular to the fibers.

The manufacture of these bikes and components is state of the art, often involving huge carbon [7] looms, advanced manufacturing robotics, and processes that rival those found in super car factories. In the case of BMC bikes (as seen above), the frame structures are woven from 100 bobbins on a circular loom around a form. The woven forms are then impregnated with CNT [5] infused resin, with the CNTs [6] filling the microscopic voids between the carbon fiber [3]. In the third stage, industrial robots perform precision cutting on the tubes, creating lengths that are appropriate for the frame being built. Each manufacture uses different proprietary processes, but the general steps and structure are the same.

References

1. Anon. **Bianchi Technology** [8]. [Internet]. 2013 . Available from: http://www.bianchiusa.com/technology/ [9]
2. Johnson D. **Nanotechnology and the Bicycle** [10]. [Internet]. Submitted . Available from: http://spectrum.ieee.org/nanoclast/semiconductors/nanotechnology/nanotechnology-and-the-bicycle [11]

Author:

Rider Foley [12]
Tai Wallace [13]

Product Name:

- Bianchi Oltre XR Super Record EPS using CNTT [14]
- BMC Impec LSW [15]
- Easton EC90 SL-X Full Carbon CNT [16]

Development Stage:

- Available, but not Ubiquitous [17]

Key Words:

- CNT [5]
- Carbon Fiber [3]
- Bicycle [18]

Mechanism:

- Passive Nanostructure [19]

Summary:

This technology is meant to enhance the strength of carbon fiber [3] bicycles without compromising the weight of the bike.

Function:

- Enhancing Materials [20]

Source:

Nanotechnology and the Bicycle [10]

Material:

- Carbon [21]

Source:

Impec: In the Beginning, There was the Tube [22]

Benefit Summary:

Infusing CNTs [6] into carbon fiber [3] bicycle [18] frames, beyond making cycling easier, is meant to enhance the safety of carbon fiber [3] bicycles.

Benefit:

- Safety [23]
- Resource Efficiency [24]

Risk Summary:

Carbon Nanotubes [4] can enter deep into the lungs, enter the blood stream, and pierce cell walls, making them toxic to living organisms. They pose little risk to the consumer since the CNTs [6] are suspended in a resin, but they pose a risk to humans during the manufacturing process, and may pose a human or ecological risk once the bikes enter the post-consumer phase [25].

Risk Characterization:

- Simple [26]

Risk Assessment:

- Ecological Risks [27]
- Health Risks [28]

Source:

Potential Release Pathways, Environmental Fate, And Ecological Risks of Carbon Nanotubes [29]
Cardiovascular Effects of Pulmonary Exposure to Single-Wall Carbon Nanotubes [30]

Facility:

- Transportation Systems [31]

Activity:

- Biking [32]

Substitute:

- Aluminum [33]
- Cro-Moly [34]
- Carbon FIber [35]

Challenge Area:

- Health [36]
- Greenhouse Gas Emissions [37]

CNS-ASU research, education, and outreach activities are supported by the National Science Foundation under cooperative agreement#0937591.

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