1
00:00:08,080 --> 00:00:04,040
Music.

2
00:00:08,100 --> 00:00:12,120
My name

3
00:00:12,140 --> 00:00:16,150
is Stephanie Getty. I use micro
and nano technology

4
00:00:16,170 --> 00:00:20,190
to make better scientific
instruments for spaceflight

5
00:00:20,210 --> 00:00:24,210
My name is John Hagopian, I am
an optical

6
00:00:24,230 --> 00:00:28,240
physicist at the NASA Goddard
Space Flight Center. The
exciting part about this

7
00:00:28,260 --> 00:00:32,250
work is; it's kind of pushing
new boundaries on what we do
with nano technology

8
00:00:32,270 --> 00:00:36,280
in terms of optics. Stephanie
Getty: It is a hollow tube

9
00:00:36,300 --> 00:00:40,300
that's made entirely out of
carbon and the diameter is a
nanometer.

10
00:00:40,320 --> 00:00:44,340
If this was the size of an
actual nanotube and you were to

scale me up

11
00:00:44,360 --> 00:00:48,390
proportionately, then I would
be tall enough to reach the
moon. Because

12
00:00:48,410 --> 00:00:52,410
the nanotubes are so small, we
can only use a scanning
electron microscope to be able

13
00:00:52,430 --> 00:00:56,440
to see them. The method that we
use

14
00:00:56,460 --> 00:01:00,450
is called catalyst assisted
chemical vapor deposition.

15
00:01:00,470 --> 00:01:04,470
That grows carbon nanotubes on
a substrate. John: You put the
substrate in this tube

16
00:01:04,490 --> 00:01:08,500
you heat the tube up to about
750C and you flow a gas

17
00:01:08,520 --> 00:01:12,550
and the gas has carbon in it.
Because of the catalyst layer
you start to

18
00:01:12,570 --> 00:01:16,600
assemble these tubes. Carbon
takes a very specific form as
it grows.

19
00:01:16,620 --> 00:01:20,640
Stephanie: So one example where

20
00:01:20,660 --> 00:01:24,700
carbon nanotubes can enhance
the performance of a scientific
instrument

21
00:01:24,720 --> 00:01:28,720
in space is through their
ability to absorb light.

22
00:01:28,740 --> 00:01:32,740
John: The Z306 paint is the
blackest thing that we put on
instruments right now.

23
00:01:32,760 --> 00:01:36,760
The fact that we are blacker
than that I guess makes us
blacker than black in terms of

24
00:01:36,780 --> 00:01:40,780
performance. When light from

25
00:01:40,800 --> 00:01:44,780
the Earth or a star hits an
instrument

26
00:01:44,800 --> 00:01:48,820
or structures inside of the
instrument it gets scattered
over all angles. A lot of the data

27
00:01:48,840 --> 00:01:52,860
gets contaminated. So, it turns
out up to 40 percent of the data

28
00:01:52,880 --> 00:01:56,890
could be unusable. Stephanie:
So, the current telescopes use
black paint.

29
00:01:56,910 --> 00:02:00,920
to reduce the reflection but
the black paint isn't perfect

30
00:02:00,940 --> 00:02:04,940
it still shows a reflection.
John: over the course of our
work, we were able to

31
00:02:04,960 --> 00:02:08,950
optimize the carbon nanotubes
to make them 10 times darker
than the paint.

32
00:02:08,970 --> 00:02:12,970
You could get a better
observational efficiency; you
are not throwing away 40

33
00:02:12,990 --> 00:02:17,010
percent of your data.

34
00:02:17,030 --> 00:02:21,020
The Goddard samples

35
00:02:21,040 --> 00:02:25,060
were grown multi walled so they
are not just single walled
nanotubes and they are

36
00:02:25,080 --> 00:02:29,100
also oriented straight up and
down. The reason that

37
00:02:29,120 --> 00:02:33,140
the oriented samples are darker
is because they are low density

38
00:02:33,160 --> 00:02:37,160
light can go in, it gets

rattled around in there and it
gets absorbed.

39
00:02:37,180 --> 00:02:41,260
Voice over launch countdown: 4,
3, 2

40
00:02:41,280 --> 00:02:45,290
1, and lift off...Stephanie:
So, when we prepare a new
technology

41
00:02:45,310 --> 00:02:49,300
for spaceflight, we need to
consider the different
environments that

42
00:02:49,320 --> 00:02:53,320
the technology is going to
experience. John: So, if we are
going to fly something in space, we can't

43
00:02:53,340 --> 00:02:57,350
have the nanotubes falling off
and contaminating mirrors. So,
we had to make sure

44
00:02:57,370 --> 00:03:01,390
that they are very robust. Over
a long period of time

45
00:03:01,410 --> 00:03:05,420
after all these experiments, we
discovered that aluminum is
really the

46
00:03:05,440 --> 00:03:09,450
trick to getting the nanotubes
to scratch them off, they are
very

47

00:03:09,470 --> 00:03:13,490
robust. Stephanie: So, we are interested in vibration testing for these carbon nanotubes to

48
00:03:13,510 --> 00:03:17,520
determine how well they adhere to the substrate and whether they will be

49
00:03:17,540 --> 00:03:21,570
liberated during launch. The other thing that we do test is thermal

50
00:03:21,590 --> 00:03:25,590
conditions. When your spacecraft is flying through space

51
00:03:25,610 --> 00:03:29,600
it gets very cold and actually it gets exposed to radiation.

52
00:03:29,620 --> 00:03:33,620
So, those are to of the other tests that we expose our technologies to before we

53
00:03:33,640 --> 00:03:37,660
fly them. John: So, the first instrument that we are using them on right now is actually ORCA.

54
00:03:37,680 --> 00:03:41,710
That's an Earth science instrument. Another thing that we've looked at is using

55
00:03:41,730 --> 00:03:45,740
them on LISA, which is a gravity wave experiment.

56
00:03:45,760 --> 00:03:49,760
Stephanie: One area where
carbon nanotubes have made it
into the

57
00:03:49,780 --> 00:03:53,790
market place is in sporting
goods, to make stronger, more
robust, lighter

58
00:03:53,810 --> 00:03:57,840
weight bicycle frames, tennis
rackets. Those are

59
00:03:57,860 --> 00:04:01,850
some examples of where you can
go out and buy carbon nanotube
composites.

60
00:04:01,870 --> 00:04:05,860
John: At this point we feel like

61
00:04:05,880 --> 00:04:09,880
we have nanotubes that are
robust, we can grow them on
different materials.

62
00:04:09,900 --> 00:04:13,930
They are very dark. So, we are
very close now to getting to
the point where we are going to

63
00:04:13,950 --> 00:04:17,970
qualify these for spaceflight
use.

64
00:04:26,020 --> 00:04:22,000
Music outro.

65

00:04:34,070 --> 00:04:30,050
Beeping sound.