Cornell University
Graduate School

Cornell University Three Minute Thesis (3MT) Competition

Ashwariya Lahariya, Fiber Science & Apparel Design: "What if Your Clothes Can Warn You of Dangerously High Carbon Dioxide Levels"

[Clock ticking]

>> Narrator: Cornell University 2019 Three Minute Thesis finalist. Aishwarya Lahariya: fiber science and apparel design: "What if Your Clothes Can Warn You of Dangerously High Carbon Dioxide Levels."

>>Lahariya: How many of you have tried to get out of a crowded room just to get some fresh air? That's me at most of the parties. It's basically because when number of people in a room increases, more people are exhaling carbon dioxide that leads to warming in the room and eventually you feel a tidbit of suffocation. Well something similar is happening on earth with increased carbon emissions because of so many human activities. We know global warming or climate change is happening and that the stage is not far when we might start feeling tidbit suffocation. So there surely exists a problem that needs to be solved but I feel the first step in addressing, like solving the problem, is addressing that there exists one. So, what if your clothes tell you every now and then that the carbon dioxide level around you is dangerously high or not or you should act about it? This can be done using a very special polymer called polypyrolle. So, usually polymers are plastics, that's what we know. But, polypyrrole is a conductive polymer. Basically, you can measure electrical resistance or electrical conductance on polypyrrole. When you add or remove an electron, the smallest part of a polymer from its structure. So, whenever carbon dioxide comes around polypyrrole, two of its electron can be shared with the structure and you can sense. So, 10 molecules of carbon dioxide give different resistance, 100 give different resistance. But how do I ensure every single molecule is trapped? For that, I make nanofibers 5000 times smaller than a single human hair. I make them using a process called electrospinning, on the top. A polymer solution flowing milliliter per hour is subjected to electric force as high as 30,000 to 45,000 volts. Your usual sockets in the house have 110 volts. So such high electric force, you literally makes the polymer molecules repel each other, fly out, and deposit on the collector as nanofibers. These are the nanofibers on a really high-resolution electron microscope. They have such high surface area that every small pore can trap every single molecule of carbon dioxide and give you a certain value of electrical resistance. So no batteries, no wiring, anything needed, you can literally deposit these polymers on clothes. These are basically flexible sensors that can go on something as small as barcode readers that you see in shopping malls and then that can be attached on your clothes. So you can easily attach them in applications like astronaut suit or a firefighter suit where it is really necessary to monitor the carbon dioxide levels around, or in buildings and close environments where if you know the carbon dioxide levels, you can increase or decrease the heating or cooling in the room, save energy. So tomorrow you shouldn't be surprised if your car tells you to go get it fixed, it is

leading a lot more carbon dioxide outside, or if your clothes tell you go out of a party or not. Thank you.

[Applause]