



PATENT



TECHNOLOGY SUMMARY

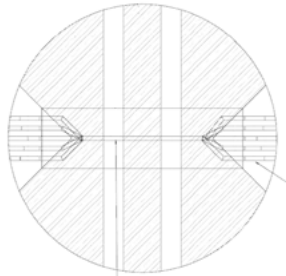
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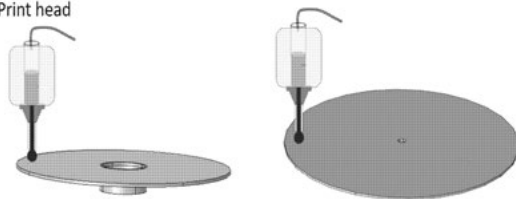
Sensors Directorate Engineer Celebrates Patently Productive Year

It's always a boon to the Air Force Research Laboratory (AFRL) when one of its scientists or engineers earns a patent to assist the warfighter. But Sensors Directorate (RY) Senior Electronics Research Engineer Emily Heckman, Ph.D. had a banner year in 2022, producing three patents for the Department of the Air Force (DAF). However, she's quick to assert her work was the result of a team effort.

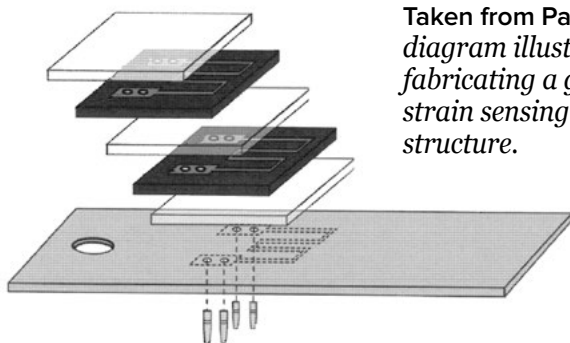
Taken from Patent 11,259,402:
An elevated view of an additively-manufactured crossover arrangement.



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Taken from Patent 11,404,773: *Illustrates the application of a conductive ink on a radiating support structure and ground support structure for an antenna.*



Taken from Patent 11,441,956: *A diagram illustrating the steps in fabricating a graphene-based strain sensing device directly on a structure.*

TECHNOLOGY

PATENT NUMBER:
US 11,259,402 B1

TECHNOLOGY NAME:
Fabrication of Electrical and/or Optical Crossover Signal Lines through Direct Write Deposition Techniques

INVENTORS:
Emily Heckman
Jeffrey Massman
Roberto Aga
Fahima Ouchen

TECHNICAL PROJECT OFFICE:
AFRL Sensors Directorate

PATENT DATE:
February 2022

PATENT NUMBER:
US 11,404,773 B1

TECHNOLOGY NAME:
Additively-Manufactured Omnidirectional Antenna

INVENTORS:
Emily Heckman
Roberto Aga

TECHNICAL PROJECT OFFICE:
AFRL Sensors Directorate

PATENT DATE:
August 2022

PATENT NUMBER:
US 11,441,956 B1

TECHNOLOGY NAME:
System and Method for Fabricating a Strain Sensing Device Directly on a Structure

INVENTORS:
Emily Heckman
Roberto Aga

TECHNICAL PROJECT OFFICE:
AFRL Sensors Directorate

PATENT DATE:
September 2022

SOURCE:
US Patent and Trademark Office
www.uspto.gov

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“It’s always, always a collaboration! Each of these patents involved a team. We work together to bounce ideas off each other, play devil’s advocate, and do the actual manufacturing and testing,” Heckman said.

Last February, Heckman – along with Jeffrey Massman, Roberto Aga, and Fahima Ouchen – received a patent for the Fabrication of Electrical and/or Optical Crossover Signal Lines Through Direct Write Deposition Techniques. Among its benefits, this technology eliminates layers of a printed circuit board (PCB) using printed crossovers. A PCB mechanically supports and electrically connects electronic components with a series of tracks using laminated copper sheets. Heckman’s team invented a method to allow more flexibility for radio frequency (RF) and direct current (DC) lines in the design of PCBs among other benefits.

In August, Heckman and collaborator Aga were awarded a patent for an Additively Manufactured Omnidirectional Antenna. The invention is an alternative way to produce omnidirectional antennas faster and more cost effective than conventional antenna fabrication methods.

Finally, the duo was awarded another patent in September for devising a System and Method for Fabricating a Strain Sensing Device Directly on a Structure. “(This) involves directly writing a strain gauge on a structure using additive manufacturing (AM) techniques,” Heckman explained. She sees these patents benefiting the DAF in terms of size and weight of previously existing technologies while being more cost effective and faster to manufacture.

One might assume this trio of patent awards came from a sudden flurry of great ideas in a short timeframe, but Heckman said it took longer than you might think.

“In most of these cases, the patents are the culmination of a few years of effort. We want to

make sure we have tested our concepts over and over before we file for a patent. They also take a while to develop. It really varies from patent to patent. Some are organically grown out of the research we are doing, and we realize we stumble across something novel (for example, the printed crossover), and some involve completely thinking about a problem in a new way and flipping traditional methods on their heads, for example, the printed strain gauge.”

Heckman, whose first love was performing onstage in the theater while in high school, gravitated to a career in science and now shares her story with students through a STEM outreach program. She also mentors both undergraduate and graduate students through internships in her laboratory at the Sensors Directorate. Her advice to both up-and-coming students and current scientists and engineers involves teamwork.

“It’s hard to work in a vacuum. My greatest advice would be to seek out a team that can help you, and of course it doesn’t hurt to work in a world class research lab surrounded by brilliant researchers.”

United States Patent Office: #11,259,402 (AFD-2082), #11,404,773 (AFD-2154), #10,770,206 (AFD-1871)

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