

Waterloo-made spectrometer lost when SpaceX rocket exploded

Terry Pender

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WATERLOO — Olga Pawluczyk's jaw dropped when the SpaceX rocket exploded over the Atlantic Ocean off the Florida coast this week — on board was a spectrometer her company built for astronauts in the International Space Station.

Pawluczyk is the president and chief executive officer at P & P Optica, which makes spectrometers for the scientific, medical and commercial markets. Spectrometers show the chemical makeup of physical objects, and are used in everything from recycling plants sorting plastic waste to searching for cancerous tumours in the human body.

"Systems that see chemistry, that's what we do," Pawluczyk said.

Out of love for the technology and a desire to push Optica's technology to new limits, Pawluczyk's team of chemists, nanotechnology engineers, mechanical engineers and software developers accepted an invitation to make a spectrometer for the International Space Station. The device would be used to engage school children and others in space experiments by an American company called Story Time from Space.

"We were just part of a mission of love, people just trying to teach other people about space," Pawluczyk said.

There is small, heavy spectrometer sitting on her desk. It is nearly identical to the one P & P Optica built for the International Space Station.

"It is a lot of work, even to send something like this into space," Pawluczyk said.

There was vibration testing to make sure it could withstand the launch, magnetic testing to make sure it did not interfere with other instruments, and the software had to be custom built so it was easy to use.

"As an engineer and scientist, everybody here, you have no idea how exciting it is to have an object you built go into space," Pawluczyk said.

The Falcon 9 Rocket that exploded Sunday was owned by SpaceX, a private company that had completed 18 successful resupply missions to the International Space Station. Pawluczyk does not know if P & P Optica will be asked to build another spectrometer for the station, but there is lots of other work for her company in the meantime.

The company was founded by Pawluczyk's father in 1995 in Quebec City as an optical design and manufacturing company. About 15 years ago it moved to Waterloo. And about three years ago it started to build spectrometers for the commercial market. It currently employs 10, and is looking to hire two more.

The company built a holographic laboratory in its Davenport Road facility. It is among only three or four such facilities in the world.

A spectrometer gathers the light that is shone through objects and analyzes the chemistry of the objects. When connected to a computer, it displays the chemical composition of the objects on graphs.

Among many commercial applications, spectrometers can be used to assess the quality of hams and bacon and make sure there are no bones in ground chicken. The devices can play a critical role in automating quality control, separation and selection in commercial markets.

"My favourite part about this company is that we see everything, from human brains to making pork to looking at tomatoes and everything in between," Pawluczyk said.

P & P Optica is among a tiny number of firms that can make what are called "diffraction gratings" — the heart of any spectrometer. The gratings have three main parts. There are two thin glass plates. A layer of specially treated gelatin is between the glass plates. That gelatin is sensitized to light with lasers. Once it is sensitized, the grating breaks the light into different colours.

The layer of gelatin in every diffraction grating is photo-sensitized differently, depending on the light it will be analyzing. This work is done to incredibly accurate standards — down to one-billionth of a metre — a nanometre.



Olga Pawluczyk, president of P & P Optica, in the Waterloo company's holographic laboratory.

"And that allows us to split light into multiple colours, very precisely and very efficiently," Pawluczyk said.

The different colours represent the different chemicals that make up the object being analyzed.

P & P Optica built a holography laboratory so it can make its own diffraction gratings. A powerful laser in this super-stable and super-clean room precisely burns the gelatin.

"We essentially dug a six-foot-deep swimming pool inside the building, filled it with concrete, sand and different materials to absorb vibrations," Pawluczyk said. "So we have a 10,000-pound table standing on a pedestal of foam. It is all floated so it absorbs every single vibration."

P & P Optica is about applying cutting-edge advances in the science of spectroscopy to commercial and industrial processes.

"Spectroscopy is a very old science — Newton was playing with spectroscopy," Pawluczyk said. "But the innovations in new optical materials, things like grating and detectors, allow us to move the spectrometers from the lab to something like a production line."

tpender@therecord.com

Terry Pender covers business and can be reached via Twitter [@PenderRecord](https://twitter.com/PenderRecord)