ADVANCED IMAGING

Advanced Imaging gets to talk to Sensors Unlimited's new CEO

By Hank Russell

Sensors Unlimited (Princeton , NJ) has recently named Dr. Marshall J. Cohen the company's new CEO. Cohen, who co-founded the company in 1991, was elected to his new position by the board of directors in April, 2004. He has since led the development of indium gallium arsenide (InGaAs) linear focal plane arrays and the first commercial InGaAs two-dimensional focal plane arrays and cameras.

He began his career in 1977, joining Rockwell International's Science Center (Thousand Oaks, CA) as a member of its technical staff. He has also worked for Chevron Research Company (Richmond, CA), Applied Solar Energy Corporation (City of Industry, CA) and EG&G Princeton Instruments (Princeton, NJ).

Cohen is the author of more than 40 scientific publications and more than 100 technical papers. He holds six U.S. patents and has directed more than 50 government-supported R&D programs. He is also an active committee chairman for the Electrical and Electronics Engineers & Laser & Electro-Optics Society. He is a 1971 graduate of the University of Michigan (Ann Arbor, MI), where he received a B.S. in Physics (cum laude). In 1975, he was awarded a Ph.D. in solid-state physics at the University of Pennsylvania (Philadelphia, PA). He remained at the University of Pennsylvania as a post-doctoral research fellow until 1977.

Advanced Imaging had the chance to speak to the new CEO about the challenges ahead, the markets the company will address and the technologies currently under development.

Dr. Marshall J. Cohen, the new CEO of Sensors Unlimited.

HANK RUSSELL, ADVANCED IMAGING: As CEO, which markets will be the company's main focus and why?

DR. MARSHALL COHEN: Our primary market is shortwave infrared (SWIR) imaging, and that divides into a number of subareas, including defense, agricultural, sorting and online process control. The reason for that is we're finding that, in the shortwave infrared, there's a lot of things that you simply can't see in visible and you can't see with thermal imagers, and also they have a whole range of useful applications. More and more industries are learning about the utility of this wavelength band, and we're starting to see an increase in business across the board.

RUSSELL: What will be the main challenges for you in your new position?

DR. COHEN: In the new position, the main challenges are dealing with the outside world — dealing both financially, as well as company-to-company above the sales level, dealing with other corporations, establishing strategic relationships, dealing with our banks — all the infrastructure of running the business. In the relationship part, we partner with other large companies, both in the commercial sector and the defense sector, to help incorporate our cameras and imaging devices into larger systems. In my new position, I'm the direct point of contact representing Sensors Unlimited in those kinds of discussions. Basically, you'll find that we have quite a wide range of standard products that our customers buy and use them to develop their applications, but once it's decided to incorporate our technology into their application, things get very customized. So you need to have a long-term relationship to make it worthwhile on both companies' parts to move forward.

RUSSELL: I was on the company's web site before and one of the sections mentioned the uses and benefits of indium gallium arsenide and the intention to grow a high-quality extended wavelength. Explain the process involved about trying to grow the extended wavelength.

DR. COHEN: When you say indium gallium arsenide, you really mean an alloy of indium arsenide and gallium arsenide, and what wavelength the resulting material is sensitive to depends on the alloy composition. When you grow any material, you have to grow it on a substrate — some kind of wafer that holds up the film you grow. If you grow the alloy that's 53% indium arsenide and 47% gallium arsenide, that alloy has the same lattice constant, the same crystal structure as the substrate, so you can end up with very high-quality material; that's what people call standard InGaAs, and it's sensitive from 0.9 micron all the way to 1.7 (microns). When we use the shorthand notion extended wavelength, we mean adding more indium arsenide to the mix and it extends the sensitivity to longer wavelengths. However, you lose that lattice match — the match of the film to the substrate — and you have to do all kinds of trips in your material growth to end up with the high-quality material. Our goal is to extend the sensitivity from where silicon leaves off — at about a micron — all the way to 2.5 microns, which is the traditional definition of a near infrared (NIR), and we believe that opens up a whole range of applications. Basically, there is no competition for the SWIR band. You'll occasionally see mercury-cadmium-telluride (HgCdTe) (sensors) and that's more for a historic reason. The military has put hundreds of millions of dollars into that, but I can't think of any commercial application in this wavelength band that uses mercury-cadmium-telluride. It's really InGaAs that's an enabling technology.

RUSSELL: Your article that you wrote with Dr. (Martin) Ettenberg in the March issue (of Advanced Imaging , "Machine Vision in the Shortwave Infrared") focused on InGaAs detectors that are used in machine vision applications. What are the advantages of InGaAs detectors over other detectors?

DR. COHEN: Again, the general answer is, in different wavelength bands, you see different things. One of the examples is, in agricultural online process control, you can see moisture content at 1.4 microns, which is beyond what a silicon camera can see. You can detect the difference, for example, between tobacco leaves and tobacco twigs, which, to a regular camera, look sort of brown (the same), but they look very different in the SWIR band.

When you bruise a fruit, you end up with a different moisture content just under the skin — this is one of the examples in the article — the bruise on an apple shows up very clearly in the shortwave infrared, where you can't see it with your eye, and then you know whether that apple goes to the grocery store or to the processing plant to make apple juice. Because you're looking in a different wavelength band, you see different things. It's common in medical applications to use the near infrared to verify the composition of pills to make sure the pill is really what you think it is. With our cameras, you can now do that online; up to now, [the procedure] has been take some pills offline and put it into an instrument. With our new techniques, you can actually do it online and eliminate the bad pills before they're included in the bottle. In steel manufacturing, in our temperature range, you can see the difference between molten steel and the slag that floats on top of it, which you can't see in the visible. In glass bottle manufacturing, you can see defects in the bottle that you can see neither with the visible nor with thermal cameras. So, it's just a class of applications that are well-suited to the shortwave infrared. I think the point is we don't change Mother Nature. The fact that something occurs in the near infrared or shortwave infrared, it just is, and through near-infrared spectroscopy, you can find out what those things are so you'll know what things you're looking at, at what wavelengths, but what we bring to the table is making cameras that are as simple and rugged as an invisible camera that allows you to take that knowledge and apply it to a manufacturing line, or a quality control laboratory.

RUSSELL: With the conflicts in Iraq still ongoing and the growing need to beef up homeland security, what have you been working on for military applications?

DR. COHEN: The military, as you may know, has been putting a lot of emphasis on what they call the "virtual army"; in other words, they're using imaging in all kinds of ways to keep real soldiers as much out of harm's way as possible, whether it's unmanned aerial vehicles, robotic land vehicles or other kinds of drones, you need imaging and you need imaging at various wavelength bands because each wavelength band sees something different. For example, in what the defense community would call passive imaging, which is just imaging with the light that's out there without shining a spotlight of your own, our camera works well with night vision under dark conditions, and particularly well at dawn and dusk, when these thermal cameras don't work very well, even when the sun's going down or rising. They work OK at daytime and at night, but not during the in-between periods. You can do things like see an enemy soldier with camouflage, you can light up an area with a spotlight; they can only be seen by our camera and cannot be seen by the enemy using standard night vision goggles. A new area is imaging laser radar (LADAR) or three-dimensional imaging. By using our camera with a pulsed laser, you can actually not only see an object, but you can see its shape in three dimensions and that helps for what they call automatic target recognition; for example, they can distinguish a school bus from a tank. The other big area in the defense community is what they call fused imaging, which is taking the images from cameras at different wavelength bands and fusing them into one image for the viewer so he gets the most information. One dramatic example is that DARPA (Defense Advanced Research Projects Agency) has a program called MANTIS (Multispectral Adaptive Networked Tactical Imaging Sensor), which is a helmet-mounted system, including four cameras — that's one visible camera, one thermal camera and two SWIR cameras — and that's a program in which we're an active participant. I mentioned that passive imaging is using the light that's out there; in active imaging, the user is providing the light and then imaging what they see. In any application that involves laser light, it's important that the laser be eye-safe, either because we use it in the presence of our own troops or even things that are just directed at the enemy. Ninety-nine percent will be used with our own troops in training, and lasers become eye-safe at wavelengths longer than 1.4 microns; therefore, it's a perfect match for the indium-gallium-arsenide camera. There are many frequencies and at every instance, they are working at rolling over to eye-safe equivalent lasers. We're already there with the ability to image. There's also a lot of work going on in laser development, plus there's an investment in current technology, but the policy is to roll everything over to eye-safe illumination. Then you'll have to have a camera that's sensitive to the shortwave infrared. We're not alone; we believe that we're the leader in technology and no one's ever alone. Competition is a validation of a good market; that's just the way we always feel. You just want to be the best.

RUSSELL: Where do you see the company going throughout the rest of the year and beyond?

DR. COHEN: As you know, we have been a large player in the telecommunications market and in fact had been bought by Finisar (Sunnyvale, CA). When the telecom market went bust, the management team here at Sensors Unlimited bought the company back and now we're a private company again. We're about a year and a half into that, and we're a growing, profitable company whose focus is on shortwave infrared imaging. Our intent is to focus on the technology; we're a technology-driven company so we can serve a wide range of shortwave infrared imaging applications. We don't buttonhole ourselves and say, "We're a defense company, we're a telecommunications company, we're an agricultural company." We're making high-quality, easy-to-use cameras in all kinds of formats. All of these industries are able to make use of our technology and that's where we see our growth coming from.

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