

A Conversation with Dr. Saad Ahmed

For eight years, Dr. Saad Ahmed has headed up XENON's Engineering Department and is responsible for the development of nearly all of XENON's sintering series of Pulsed Light systems, including our multiple lamp, S-5000 and the industry's first wide-width, roll-to-roll sintering system for printed electronics' production; the S-5100.

Most recently, Dr. Ahmed, along with his team of dedicated engineers, developed a high-Intensity, low-cost benchtop system, the XENON X-1100, which is being used in R&D laboratories around the world for a variety of applications in life sciences and printed electronics. The X-1100 delivers up to 9 Joules/cm² radiant energy/pulse, connects to a standard main outlet, and sets up in minutes.

We caught up with Dr. Ahmed to talk about XENON's equipment, science in general, and what advice he has for future scientists.

Q1. What do you feel has been the most significant advancement in science to date?

Recently, there have been a number of noteworthy events that have changed the direction of science as we know it. This includes the discovery of a previously theoretical particle called the Higgs boson, or "The God Particle." With the recent passing of Stephen Hawking, we remember his groundbreaking discovery that black holes are not really black, but actually glow black. This brings together really abstract notions about the universe that we live in. What amazes me about these discoveries is how they can be conceptualized in the human mind.

As Arthur C. Clarke said, "Any sufficiently advanced technology is indistinguishable from magic." I see the advent of quantum computing as an example of just this kind of technology. Like magic, it solves math problems that would take years with conventional computers, and it does it in seconds. This could impact everything from basic search engines, to cryptography, to how we go about making new discoveries. The cool thing is that it uses bits called q-bits, quantum mechanics, and the weird notion of parallel universes.

Q2. In a previous interview, you mention a strong interest in Artificial Intelligence. What about that intrigues you?

We think of intelligence as a mainly human characteristic. Words like knowledge, understanding and reasoning are all things that we relate to a being with a soul and a mind. Imagine that you took a true AI system and put it inside a box and in another box you put a human. If you ask questions and are unable to distinguish whether you are talking to a machine or human, wouldn't you have then created another being? AI promises to be an integral part of our lives, with self-driving cars and autonomous robots. Perhaps a time will come when questions of responsibility, and ultimately, the value of artificial life forms are compared to humans. This will all need to be resolved.

Q3. As an early adopter of Printed Electronics technology and developer of several Sintering Solutions, where do you see the market in five years? Do you see it being incorporated in everyday life?

Remember, my reference to "magic" above. Well printed electronics, and the promise it holds in my mind, is akin to this kind of magic. There are so many components that need to come together for the technology to work, and for it to become a viable solution that could revolutionize the world. As a way to demonstrate how all the components together in a single system, we developed the Centauri system. It is groundbreaking in that, for the first time, people can see all of the parts and pieces together, starting from ink and some plastic, and ending up with a working printed circuit.



XENON has been in the PE scene for many years. I remember soon after I joined the company eight years ago, I was talking to the CEO of an ink company who was working on a copper ink that could be photo-sintered. He said "It works, but we need a lot more energy". Copper inks were to be the "Holy Grail" of printed electronics. The hope was that copper would become a low-cost alternative to silver, but it turned out conventional ovens that sinter silver inks were not an option for copper. Copper oxidizes readily and copper oxide is not conductive, as opposed to silver oxide which is conductive. Copper inks come and go but there has not been a definite useable copper solution. Silver inks don't seem cost effective. That was the start of the Sinteron family of systems, which we now call the S-2100.

As time went on, we realized that better and more precise pulse control was required for this system, which led to the development of a range of products with digital pulse controls. We developed wide-width solutions and high-speed systems with multiple lamps, systems like the S-5100 have all the bells and whistles to enable roll-to-roll production.

This illustrates my utmost optimism with this market and is one of the benefits of XENON being the Pulsed Light Experts. It is clear that offering low cost, small scale laboratory equipment like the X-1100 is accelerating technology development by giving process developers and ink manufacturers a tool to evaluate and optimize photo-sintering.

I see deployment starting off in high end solutions like medical and the military, and then moving down to large scale production. What is encouraging is that these applications are emerging and thus will breed further successes. Ultimately, this technology could become like another home appliance, like your printer, where you would download and print out your microwave or television. Far fetched perhaps? Don't forget it's like magic.

Q4. What advice would you give to students interested in pursuing a science-focused career?

Well, the exciting thing about science, and by that I mean any science field, be it astronomy, medicine, engineering or computers, is that there is always a connection to the word "creation". In engineering we are creating machines, or tools, or toys. In other cases, like astrophysics, we're trying to make sense of creation and perhaps put an equation to it. In medicine, we are affecting creation... of us. There is nothing more rewarding than creating something from nothing, like a poem, or a machine that can learn. This skill, which is currently limited to humans, is not restricted to science, but includes things like literature or art, where something can be created, and be a part of that creation even when its frail creator is long gone. More important than creativity however, is enjoyment.

Our vision of the future is only limited by our imagination. So it's important to practice the art of thinking big. I remember in *Through the Looking Glass* by Lewis Carroll, the Queen says, "Why, sometimes I've believed as many as six impossible things before breakfast." Science is all about imagining the impossible and trying to understand why. There is nothing more fun than these mental puzzles, learning how to view them and apply the rules to play with them. My Golden Rule is "if it isn't fun then it isn't worth doing." I would strongly recommend for those interested, to try it, and see if you can find the fun in it, and, if you do, then I'm sure you will be as hooked on science as I am.

Pulsed Light Discoveries

The use of deep ultraviolet light for the direct breakdown of volatile chemical contaminants in air has been the subject of speculation and experiment for almost thirty years now, but has not yet been utilized on anything but experimental scale. Some of the more important contaminants are known by three-letter initials, such as Trichloroethylene (TCE), Tetrachloroethylene (PCE, so called to distinguish it from TCE; It is also known as Perchloroethylene), 1,1,1 Trichloroethane (TCA), Carbon Tetrachloride (CT) and Chloroform. Many volatile compounds are toxic if inhaled, and reducing their concentration in waste disposal situations or in exhaust from industrial processes is desirable. Fortunately, many can be dissociated by short ultraviolet irradiation that directly breaks chemical bonds. Benzene has absorptions at 184 nm and 202 nm. Acetone has dissociation and absorption bands at 220 nm and 318 nm, and TCE has a strong absorption at 230 nm.

In 1994 Schneider et al. demonstrated that pulsed ultraviolet light from Xenon Flashlamps could be used to break down volatile organic compounds (VOCs) in air at Savannah River in Georgia. They tested for twenty five such VOCs, but concentrated on PCE, TCE, and TCA. They found that they could achieve virtually complete breakdown of PCE and TCE, but that TCA required longer and more intense irradiation. Nevertheless, it was a practical *in situ* demonstration of the capabilities of Xenon Flashlamps for VOC amelioration.

More recently Chinese researchers have been looking at deep ultraviolet light for breaking down not only VOCs but also nitrogen and sulfur oxides in industrial exhausts as a way of reducing pollution from manufacturing. Their work has utilized both ultraviolet light alone and in combination with photocatalysts. Gases treated this way include benzene, methylbenzene, ethylene, α -pinene, and chlorinated methanes (including carbon tetrachloride)

Happenings Around Town

Taste of Science Festival | 4/22-28

The annual Taste of Science Festival that takes place in Boston and Cambridge offers several conferences based around various scientific topics given by actual scientists that break it down in layman's terms. Just a few conferences that will be discussed are "Dissecting the Mind," "The Benefits of Vices," which explains the impacts of stress and alcohol on the brain, and "The Neuroscience of Music." For more information, check out (www.tasteofscience.org) RSVP

MayFair at Harvard Square | 5/6

The annual MayFair at Harvard Square is an event for the whole family, with over 120 artisans and merchants selling arts and crafts, jewellery and clothing; 40 different food vendors will be present, international and local. Thirsty? There will also be four different beer gardens, as well. Free

Scooper Bowl | 6/5-7

Head over to City Hall Plaza in Boston's Government Center for the nation's largest all-you-can-eat ice cream event in honor of the Jimmy Fund's 36th annual ScooperBowl. 86% of all proceeds go to the Dana-Farber Cancer Institute. \$5.00-\$10.00, Noon to 8:00p

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Coming Events

• BIOMEDevice Boston 2018 | Boston, Massachusetts, USA | April 18-19, 2018 | Booth 235

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