Transcript: What Can We Do to End LED “Droop”?

Reported by Ashley Ahearn

Daniel Dapkus: So an LED is a solid-state device, much like an integrated circuit that, you know, we use every day in electronics except that when current is passed through one of these devices, the current goes into emission of light, and so positive and negative charges come together and they lose energy, and when they lose their energy, it comes out in the form of light

Ashley Ahearn: Electrical engineer Daniel Dapkus is now a professor at the University of Southern California, but back in the 1970s he led an industrial research team that developed a new materials technology for fabricating LEDs. For the first time, engineers could precisely control the material composition and thickness as they constructed LEDs, literally, atom by atom. Because of this unprecedented control, LEDs and other devices could be made with whole new capabilities.

Daniel Dapkus: It sort of revolutionized the way people made LEDs and lasers and solar cells as well. And so now you often see blue and red, very bright, LEDs available in electronics stores, and all of those are fabricated using this technology that we worked on in the late ’70’s.

Ashley Ahearn: In his office Dapkus pulls out a little box with tiny LED bulbs that light when he presses buttons, showing the current range of LED colors.

Daniel Dapkus: For example that’s a red LED and then as I go along this sequence of buttons the color will change from red to orange to amber to green to blue-green to blue.

Ashley Ahearn: LED colors are based on the material used to make them. For example, bright red LEDs are made with indium gallium phosphide. Dapkus’s group paved the way for the later research that allowed LEDs to be made with gallium nitride-- which makes them emit blue light. From there, the blue LEDs could be modified to emit green light.

Daniel Dapkus: You then had three different materials that could emit in the red, green and blue regions of the spectrum and those are like the three primary colors to which our eye is sensitive, and when we perceive all three of those colors we see what amounts to white light.

Ashley Ahearn: That opened the door for LEDs to be used in more consumer products. Instead of just being used as indicator lights on electronic devices, white LED light became the more energy efficient replacement for many light sources.

Daniel Dapkus: LEDs are now used as backlights for computer displays, and in fact, California just passed regulations saying, imposing very strict energy standards on large screen TVs. And so many manufacturers are going to backlighting LCD televisions with LEDs. So the screen you look at is an LCD display but the light that comes through it is generated by LEDs that are behind it.

Ken Lowe: So we’re looking here at our latest 55 inch LED backlight TV. We have 1200 LEDs direct ray backlight.

Ashley Ahearn: Ken Lowe is the co-founder of Vizio, a television and electronics company based in Irvine, California.

Ken Lowe: The exciting thing about the LED technology is you get brilliant colors and you can get really, really thin beautiful-looking screens. So the LED allows us to make a better picture quality, a better viewing experience and a lower energy consumption.

Ashley Ahearn: Lowe shows me a new TV that uses almost 100 watts less electricity per hour than the previous model. This new one was made with LED backlighting.

Ken Lowe: All the major brands are using LED as a backlight in their lineup. And we truly believe that this is the way to go, with so many more TVs going to the customer's homes and now they're using a larger TV so now we want to keep the energy consumption down.

Ashley Ahearn: Daniel Dapkus has been working on LEDs for the past 40 years. His vision for the technology doesn't stop at televisions.

Daniel Dapkus: It feels good to know that you've made a contribution to this. Unfortunately we're still struggling to get LEDs to be widely used for household lighting.

Ashley Ahearn: The U.S. Energy Department says artificial lighting accounts for almost 15 percent of the typical household's electrical use. Since it's now possible to create white light from LEDs, Dapkus sees huge potential for energy savings if people replace their old light bulbs with more efficient LEDs.

Daniel Dapkus: It would be hundreds of coal-fired power plants that wouldn't be required because you use solid-state lighting. It's really impressive.

Ashley Ahearn: Unfortunately, while the electronics industry has figured out how to mass produce LEDs for televisions and other appliances, LEDs are not yet mass-produced for home lighting use. For one thing, they're generally not well adapted for traditional light sockets and household power circuits. And, they're by far the most expensive light bulb on the market. So, Dapkus is focused on making LEDs more practical-- researching new manufacturing techniques, including the use of nanotechnology.

Daniel Dapkus: Nanotechnology is helping us because some of the physical structures that we would like to investigate are tiny. They're nanometer in size. And so the ability to assemble small structures that are a sub-fraction of a hair-width in dimension and to use those as the light emitting structures is what we're attempting to do, so-called nanowires. And these are LEDs but they're just in a form factor that's very tiny and we hope to use arrays of them to emit light more efficiently and to extract the light from the chip more efficiently.

Ashley Ahearn: Nanowires, arranged in the right way, would allow more light to escape from an LED. In fact, Dapkus believes they could double the amount of light visible from an LED.

Daniel Dapkus: One of the challenges in an LED is that the chip itself emits light very efficiently internal to the physical structure. And because of the characteristics, the optical characteristics of the material,

the light has a difficult time emerging from the chip, and so, you know, people do all kinds of things to shape the chip and to embed it in materials that enable the light to come out more efficiently, but even at that, the maximum amount of light that you can get out of the chip is about 50 or 60 percent. We think that these nanostructures will allow us to extract essentially all of the light.

Ashley Ahearn: The more energy-efficient researchers make LEDs, the more incentive to incorporate them into the mainstream. When Dapkus thinks about the energy that could be saved, there's no doubt in his mind that all the hard work will be worth it.

Daniel Dapkus: As soon as they become available I'm going to outfit my home with LEDs wherever I can. I'm a believer. (laughs)

Ashley Ahearn: I'm Ashley Ahearn in Los Angeles.