Justin Schwartz

Educational background:
B.S. University of Illinois, Nuclear Engineering, highest honors,1985; PhD, MIT, Nuclear Engineering, 1990

Present company/position:
Kobe Steel Distinguished Professor & Dept. Head, Dept. of Materials Science & Engineering, North Carolina State University

At what age did you realize that science/engineering is what you wanted to pursue?
As a child I always excelled at math, and my father was a Professor in Materials Science at Northwestern University, so a pathway into science or engineering was always clear. I attended Evanston Township High School which offered a unique integrated AP Chemistry-Physics program, and I think that that reaffirmed a science/technology career path.

How did your education and early career lead to your initial and continuing interest in Superconductivity?
In graduate school I decided very early to pursue fusion power from the technology side rather than the plasma physics side. But I also wanted to go into an area that was growing and that had the potential to impact systems in addition to fusion. I took a class in Nuclear Materials, and had to do a research paper, so I wrote about the role of microstructure on transport behavior in Nb_3Sn, and that was my entrance into superconductivity. My graduate research then focused on very high field superconducting magnets for fusion reactors, including stability issues. During my time in graduate school, high temperature superconductivity was discovered, sealing my long-term path.

As I was finishing graduate school I learned of a relatively new program in Japan, supported by what was then the Science & Technology Agency of Japan and the Japanese Society for the Promotion of Science. This program provided funds for non-Japanese young scientists to spend 6 months to 2 years in a Japanese national laboratory. I had the opportunity to work in Hiroshi Maeda's group at the National Research Institute for Metals (now National Institute for Materials Science), joining the group only about a year after the discovery of Bi-Sr-Ca-Cu-O superconductors. This was 1990, and our research focused on Ag-sheathed tapes of Bi2212. The race for developing high current density HTS conductors had begun.

Are you an IEEE member?
I have been an IEEE member since 1993, and was very proud to become one of the youngest IEEE Fellows in 2004.

What are some of your research interests?
Generally speaking, I am interested in understanding the underlying science that drives the important technologies needed to advance superconducting applications. This includes superconducting materials (primarily electrical transport and electromechanical properties), quench detection/protection, insulation, and integrated magnet manufacturing. At present, my group is focusing on a novel approach to forming superconducting (RE)BCO (RE)BCO joints, optical fiber sensors for quench detection and strain sensing, fatigue behavior, and Bi2212 wire and magnet processing.

Do you have any new or exciting projects/ventures you are working on that you would like to share with the community?
I think the most exciting ventures at present are the integration of optical fibers into HTS magnets, and the pursuit of superconducting REBCO joints that are easy to implement.

What do you feel has been the biggest breakthrough in Superconductivity in your lifetime?
That's easy – the discovery of superconductivity in oxides at temperatures well above anything predicted by BCS has been transformational to the field and will ultimately be revolutionary to our world.

What are your contributions to the Superconductivity field?
I've worked on Bi2212 tapes and wires for over 25 years, including co-leading (with Ken Marken) an early partnership between the National High Magnetic Field Laboratory and Oxford Superconducting Technology that was first to break the 25 T barrier. This was a target set by the Seitz-Richardson report in 1987 (before HTS was discovered), and triggered a world-wide race for high field HTS magnets. Since then, my group has partnered with a number of small businesses in the US and have made impact in a number of areas important for high field Bi2212 magnets. Most recently, we have been leading in the development of Rayleigh-interrogated optical fiber (RIOF) sensors for quench detection. RIOF offers distributed sensing at high spatial and temporal resolution, something that superconducting magnets have never had. One of my former PhD students and I have started a small business, Lupine Materials and Technology, to advance RIOF and other superconducting and magnetic materials.

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But my biggest contribution to the superconductivity field has been the PhD students I have advised and who have remained in the field. I am most proud when I see so many of them having an impact on the superconductivity industry and national labs across the country.

What are some of the most promising opportunities you see in the Superconductivity field?

There are so many! The impact of the success of the LHC is tremendous, and the opportunities for the field offered by the next two LHC systems (high luminosity and high energy) are vast. Furthermore, the 30+ years of medical MRI has cemented superconductivity in medical diagnostics, and I think the long term opportunities there are also great. But potentially the biggest opportunity remains in power systems – yet it remains unclear how or when superconductivity will enter this market broadly.

What advice would you give a young scientist/engineer interested in superconductivity?

Read the literature. Learn the history of superconductivity R&D, so you don't repeat things that have been tried (there is far too much historical redundancy in the superconductivity literature). Secondly, for those going into HTS magnets in particular, understand why things evolved as they did in LTS magnets, so you can reassess the dogmas we follow and find new ways to take advantage of the properties unique to HTS materials.

Interview conducted by Jennifir McGillis,
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