

Flexible Display Center at ASU: Management Team



Nick Colaneri, Ph.D., is the *Center Director* with responsibility for strategic vision, funding acquisition, program goals, member recruitment and new business development. Nick has been involved in organic technologies since the discovery of polymer electroluminescence during his work as a Post Doctoral Research Assistant in Cambridge in 1989. He received his Ph.D. in Physics in 1987 from the University of California at Santa Barbara under the supervision of the 2000 Nobel Laureate in Chemistry, Professor Alan Heeger. Following post-doctoral research in the laboratories of Cavendish Professor Sir Richard Friend, FRS at Cambridge University, England, he became a founding employee of UNIAX Corporation in 1990. Over the following ten years, UNIAX became a global leader in the development of light emitting polymer technology. During that period Nick served in a variety of technical and business roles, eventually being named VP of Business Development in 1998. He was a member of the

executive team that arranged and completed the sale of UNIAX to the DuPont Corporation in 2000, and subsequently became Director of Strategic Planning for the new DuPont Displays SBU until 2003.



Douglas Loy, Ph.D., *Director of Technology*, is responsible for developing research proposals for additional program funding, and working as a liaison with other university synergistic engineering research projects. He is active in developing material technologies, handling processes, and toolsets for pilot line applications including: permanent and temporary adhesives and associated bond/debond tools and manufacturing processes. Prior to FDC, Dr. Loy was Director of Technology Assessment and cofounder of E3 Innovation where he performed competitive intelligence and technology assessments for clients. Before forming E3, he worked at Three-Five Systems where he charted an R&D program on OLED displays. Dr. Loy came to Three-Five Systems after serving as Sr. Research Chemist at Polar Vision where he worked to improve the stability of polarizer films for display applications. He brings an extensive technical background in basic and applied research of new electronic materials and display

technologies. He has 5 issued patents in the field of organic electronics. His directed research efforts include the development of polarizing films with increased environmental stability, fabrication and testing of small molecule and polymer optoelectronic devices, and the development of organic electronic materials with improved thermal stability. Dr. Loy earned a Bachelor's degree in Chemistry Physics from Kean University and a Ph.D. in Chemistry from the University of Southern California.



Mark Strnad, *Director of Operations* was involved early-on with the conceptualization, award and development of the Flexible Display Center. His responsibilities include: transistor array and display panel test and characterization; display integration; OLED processing; operational scheduling and space allocation; tool installation and maintenance; EH&S and facilities interfacing; and pilot-line cost modeling. His vast industry experience ranges from managing small research and development laboratories to clean room production of 1,000, 8-in. wafers per day, as well as a test/assembly operation with shipments of 2,000,000 memory devices per month. Mark was involved with several product ramp-ups from the R&D level thru manufacturing. He has held senior management roles at companies such as Honeywell, Hitachi, and Hyundai, and managed wafer fabs, test, assembly, and facility operations. His experience includes start-up of the Greenfield wafer fabrication operation for

Hyundai and commissioning of the first Hitachi module assembly area outside of Japan. He has given numerous presentations on roll-to-roll manufacturing of flexible electronics at the USDC and AIMCAL conferences and co-authored the chapter on "*Roll-to-Roll Manufacturing of Flexible Displays*" in the SID book for Flexible Flat Panel Displays. He has a B.S. Chemical Engineering, Magna Cum Laude from Arizona State University.



Jann Paul Kaminski, Ph.D., is the *Director, Display Systems* responsible for technology demonstrator projects and managing design and assembly efforts for full device integration, including backplane design, electronic drivers, interconnects, system and timing controllers, panel, module and demonstrator builds, final test and exhibitions. Jann received his doctorate from the University of California at Santa Barbara in 1989 in Physics. He continued at UCSB as a staff lecturer and researcher until joining UNIAX Corporation in 1996, a global leader in organic polymer electronics. While at UNIAX/DuPont Displays, Jann was manager of the Display Engineering Group: responsible for polymer OLED display designs, architecture, test, assembly, pixel and system electronics. In addition, he led the OLED design, test and electronics technology transfer to domestic and off-shore licensees for commercial production of OLED displays.

With start-up companies and as an industry consultant, Jann has used his background to develop hardware/ software solutions, electronics and demonstrators for a variety of emerging display technologies, sensors and flexible electronics, including LCD, chLCD, PDLC, smOLED, PLED, EPD, LED. He has been at the Flexible Display Center at ASU since 2006.



Kristin A. Gillis is the *Director, Program Management* employed at the Center since its inception in 2004 with responsibility for developing business plans, management plans, policies and procedures; the Annual Program Plan comprised of annual projects, schedules and budgets, and development and oversight of the project management process. Early in her career she worked as an analytical chemist in the NASA Space Shuttle and Naval Sea Commands Systems, materials testing for Confined Atmosphere Control Programs. As Principal Scientist and Supervisor of several laboratories, she gained an extensive background, with over 18 years of experience in the aerospace industry, developing and managing program requirements, standards, and controls; strategic and annual planning in a multi- and complex engineering project environment; guiding process improvement initiatives; writing large-facility management proposals; and managing hazardous test facilities. Prior to joining

the FDC, she worked for Honeywell, Allied Signal, and Lockheed-ESC primarily at the NASA-JSC White Sands Test Facility. She graduated from New Mexico State University, earning Bachelors' degrees in Chemistry and Biology where she later earned an M.B.A.



David R. Allee, Ph.D. is the *Director of Research for Backplane Electronics* investigating a variety of flexible electronics applications. He has been a regular consultant with several semiconductor companies on low voltage, low power mixed signal circuit design. Since joining ASU, his primary focus has been on mixed signal integrated circuit design. As a founding member of the NSF Center for Low Power Electronics and the Whitaker Center for Neuromechanical Control, he has designed several custom analog-to-digital converters and telemetry ICs. While at Stanford University, and as a Research Associate at Cambridge University, he fabricated scaled field effect transistors with ultra-short gate lengths using custom e-beam lithography. He also invented several ultra-high resolution lithography techniques including direct e-beam irradiation of SiO₂, and nanometer scale patterning of various organic and inorganic films

with scanning tunneling lithography (ASU). He has co-authored over 60 archival scientific publications. He received a B.S. in Electrical Engineering from the University of Cincinnati in 1984 and the M.S. and Ph.D. in Electrical Engineering from Stanford University in 1986 and 1990, respectively. He was a post-doctoral fellow at Cambridge University in 1990 and 1991.

New Materials, Devices and Processes R&D Group

Terry Alford, Ph.D. works with the FDC by providing mechanical testing, materials characterization and inorganic oxide TFT support. He joined the ASU faculty in 1993 and is currently a professor in the Chemical and Materials Engineering Department and an affiliate professor in the Electrical Engineering Department. Dr. Alford's research interests include silver and copper metallization and low-k dielectrics for future integrated circuit (IC) technologies; advanced metallization for low-power electronics and for novel IC components; and formation and adhesion of sol-gel hydroxyapatite-metal systems for biomedical applications. His teaching interests include X-ray and electron diffraction, physical materials science, structure and properties of materials, advanced materials issues in semiconductor processing, and materials processing and synthesis. Honors and distinctions include: National Consortium for Graduate Degrees for Minorities in Engineering and Science (GEM) Alumni Award - Outstanding Achievement in Academia 2001; Golden Torch Pioneer of the Year Award - National Society of the Black Engineers 2001; Trailblazer Award - ASU Student Chapter of National Society of the Black Engineers 2001; National Science Foundation Faculty Career Development Award 1996. He earned his Ph.D. in Materials Science and Engineering from Cornell University in 1991.

Constantine A. Balanis, Ph.D., works with the FDC on flexible antenna design, fabrication and test. Dr. Balanis has been a Regents' Professor in the Department of Electrical, Computer and Energy Engineering (ECEE), ASU since 1983 and has a distinguished record as an educator and researcher spanning over 45 years. He received the BSEE degree from Virginia Tech, MEE degree from the University of Virginia and Ph.D. degree in Electrical Engineering from Ohio State University. From 1964-1970 he was employed by NASA Langley Research Center, Hampton VA, and from 1970-1983 he was with the Department of Electrical Engineering, West Virginia University. His research interests are in computational electromagnetics, smart antennas, and multipath propagation. He received a Honorary Doctorate from the Aristotle University of Thessaloniki in 2004, the 2005 IEEE Antennas and Propagation Society Chen-To Tai Distinguished Educator Award, the 2000 IEEE Millennium Award, the 1996 Graduate Mentor Award, ASU, the 1992 Special Professionalism Award from the IEEE Phoenix Section, the 1989 IEEE Region 6 Individual Achievement Award, and the 1987-1988 Graduate Teaching Excellence Award, School of Engineering, ASU. He has published 4 books (*Antenna Theory: Analysis and Design*, *Advanced Engineering Electromagnetics*, *Introduction to Smart Antennas*, and *Modern Antenna Handbook*) authored 8 book chapters, 132 refereed journal/transactions papers, 8 magazine/newsletter articles, 224 conferences/symposia papers, and numerous other invited talks and presentations, including keynote and plenary session talks, and is a Life Fellow of the IEEE. Dr. Balanis established a consortium, titled *Advanced Helicopter Electromagnetics (AHE)*, with partners from industry and government in January 1990 with objectives to address a wide range of theoretical, numerical and experimental research issues, including development of rigorous analytical models, computer codes, geometrical modeling interfaces, precise antenna measurements, and new antenna technology, especially when the radiating elements are placed on complex platforms, such as helicopters and ground-based vehicles. The consortium is now in its 20th year and has provided funding for numerous projects. For more details on this consortium, visit: <http://www.fulton.asu.edu/~balanis/AHE>

Lawrence T. Clark, Ph.D., an Associate Professor at ASU, has worked with the FDC on a-Si circuits and thin film transistor modeling. He joined ASU in 2004 and has approximately 15 years of industry experience at Intel and VLSI Technology Inc. He contributed to a number of microprocessor and chipset designs and was most recently a Principal Engineer and Circuit Design Manager for the Xscale microprocessors. He also worked on compact modeling, reliability modeling and CMOS imagers. Dr. Clark's expertise is in low-power, high-performance VLSI radiation hardening and harsh environment VLSI CAD and device behavior for VLSI. Prof. Clark has over 45 patents and about 15 pending, and has published approximately 30 papers. Honors and distinctions include: Intel Achievement Award for XScale microprocessor design; senior member of IEEE; Intel Divisional Recognition Awards for cache design tools, drowsy leakage control mode; member of the IEEE Custom Integrated Circuits Conference technical committee; and past reviewer for IEEE Spectrum, IEEE, and JSSC. He received his B.S. of Computer Science from Northern Arizona University in 1984, M.S. of Electrical Engineering in 1987 and Ph.D. of Electrical Engineering in 1992, both at ASU.

Ghassan E. Jabbour, Ph.D., is an Adjunct Research Professor at the ASU School of Materials Engineering. Prof. Jabbour's research interests are related to: flexible-roll-to-roll-electronics and displays, smart textile, moisture and oxygen barrier technology, transparent conductors, organic light emitting devices, organic and hybrid photovoltaics, organic memory storage, organic thin film transistors, combinatorial discovery of materials, nano and macro printed devices, micro- and nanofabrication, biosensors, and quantum simulations of electronic materials. His work has been highlighted in national and international journals and magazines including Nature, Science, PC Magazine, Wired Magazine, LA Times, Boston Globe, Financial Times (London), USA Today, and many others. Among the many awards, he received the Presidential Award for Excellence from the Hariri Foundation in 1997, and the Best Poster Award at the National Academy of Engineering (USA) Japan-USA Frontiers of Engineering Conference (2006). Professor Jabbour is also the Director of the Advanced Photovoltaics Center, and the Associate Editor of the Journal of the Society for Information Displays (JSID). He was the Track Chair of the Nanotechnology Program for the SPIE Annual Meeting (2001-2004), and the Secretary General for the Materials Secretariat of the American Chemical Society (2001). Professor Jabbour has served as the chair and/or co-chair and on the committees of over 110 conferences related to photonic and electronic properties of organic materials and their applications in displays and lighting, transistors and solar cells, hybrid photosensitive materials, and hybrid integration of semiconducting materials. He has more than 300 publications, invited talks and proceedings. Professor Jabbour attended Northern Arizona University, the Massachusetts Institute of Technology (MIT), and the University of Arizona. Prof. Jabbour is an SPIE fellow.

Jian Li, Ph.D. is an Assistant Professor at the ASU School of Materials with research interests including: design and synthesis of advanced materials for the application in organic semiconductor devices including organic light emitting devices, organic photovoltaics, organic memory and organic thin film transistors. He has studied the mechanism of charge-transporting, energy transfer, and radiative or non-radiative decay of excited state molecules inside the organic solids. He has expertise in design and synthesis of organic semiconductor materials and structure, and electrical and optical properties of organic and inorganic molecule and molecule aggregate. Dr. Li received his B.S. Chemistry at Fudan University in 1997, M.S. in 2004 and Ph.D. in 2005 both at the USC.

Robert J. Nemanich, Ph.D. is Professor and Chair of the ASU Department of Physics. His research has been primarily in the area of electronic materials, and has focused on growth, processing and characterization of surfaces, interfaces, thin films and nanostructures. He earned BS and MS degrees in Physics from Northern Illinois University, and a Ph.D. from the University of Chicago. In 1976 he joined the Xerox Palo Alto Research Center and was a project leader in the General Sciences Laboratory and in the Integrated Circuit Laboratory. In 1986 he moved to NC State and has been the recipient of the NC State Alumni Association's Outstanding Research Award (1994) and the Distinguished Graduate Professorship (2001). He joined ASU in 2006. Nemanich has a long-standing involvement with the Materials Research Society and has served as 1998 President, and the 2003-2004 President of the International Union of Materials Research Societies. He is a Fellow of the American Physical Society and is currently Chair Elect of the Division of Materials Physics. Nemanich is the Editor-in-Chief of the research journal Diamond and Related Materials, and serves on the Editorial Board of the Journal of Applied Physics and Applied Physics Letters.

Bryan D. Vogt, Ph.D. is an Assistant Professor with the Chemical Engineering Department with expertise in nanostructure materials thin films microelectronics. Prior to joining the chemical engineering faculty at ASU, Dr. Vogt was a staff scientist in the Polymers Division at the National Institute of Standards and Technology (NIST) in Gaithersburg, Md. His activity while at NIST focused on characterization of thin films and interfaces for electronic applications. During this time, he had active collaborations with numerous industrial partners including IBM, Intel, and Sematech. His current research efforts are focused predominately in the characterization of advanced materials to elucidate structure-property-processing relationships towards the development of improved materials in two thrust areas: electronically active polymers and polymer templated nanostructures. These ubiquitous materials have potential application in electronics, displays, sensors, smart coatings, catalysis, renewable energy, and pollution control technologies as examples. Professor Vogt received his B.S. Chemical Engineering from Michigan Technological University 1998 and Ph.D. Chemical Engineering from University of Massachusetts 2003.

Principal and Design Engineering Staff

Scott Ageno, *Principal Test Engineer*, directs development and operation of photolithography and etch processing for fabricating flexible TFT backplanes. He has been instrumental in characterizing distortion of flexible substrates during TFT processing. An accomplished process engineer, with over 22 years of experience as a device engineer, and program manager for fabrication of electronic devices using a wide variety of materials and substrates. His early career was spent at TRW, Inc., where he helped advance the state of the art in GaAs/AlGaAs high electron mobility transistor (HEMT) technology. At Motorola, Inc., he helped develop the company's vacuum field emission display (FED) technology starting from research, through development, and finally to pilot manufacturing. His most recent experience prior to employment at the FDC in 2004, was as a manufacturing engineer at Imation, Inc. where he applied Lean Manufacturing to the fabrication of Linear Tape-Open (LTO) magnetic data storage cartridges. Mr. Ageno received both his B.S. in Chemical Engineering, as well as his M.S. in Electrical Engineering, from ASU. He holds six U.S. patents.

Edward J. Bawolek, PE, Ph.D., *Principal Test Engineer*, joined the Flexible Display Center in December 2004. He is group leader for manufacturing test operations and is responsible for instrumentation and automation of precision current measurements in the femto-ampere regime. He has over 25 years of manufacturing, research and development, and management experience in areas spanning semiconductor processing, integrated circuit design and test, and metallurgical processing and has performed advanced research in optical scattering and characterization. Prior to joining the FDC, his circuit design work included both digital and analog applications with emphasis on IC power distribution and signal integrity. Dr. Bawolek's semiconductor process expertise includes photolithography, plasma etching, and defect reduction engineering, both as an individual contributor in research environments, and as a group leader in manufacturing. He earned a B.S. with Highest Distinction in Metallurgical Engineering from the University of Arizona in 1978, an M.S. in Materials Science and Engineering from Northwestern University in 1982, and a Ph.D. in Electrical Engineering from Arizona State University in 1992. Bawolek is also a Senior Member of the IEEE, and member of the Optical Society of America where he serves as a reviewer for refereed publications. He holds professional engineering registrations in the State of Arizona for both Metallurgical Engineering and Electrical Engineering. Bawolek has twenty-seven issued U.S. patents, primarily in the field of digital imaging applications. Additionally, he has been a registered patent agent since 2000.

Cynthia S. Bell, *Principal Test Engineer*, is responsible for FDC display assembly and optical testing operations. Before joining FDC, she consulted on clinical applications of image sensors and was a Senior Imaging Systems Engineer at Intel where she developed imaging product architectures for solid state image capture and display devices and served as an advisor for Intel Capital's imaging sector portfolio. Prior to Intel, she was with the Eastman Kodak R&D Labs where her accomplishments included designing the first drive circuits and image processing for OLED display materials. She was also instrumental in developing the first commercial DSLR camera and predictive models of digital image quality. Cynthia has over 25 years experience in imaging systems engineering and R&D program management. As a result of her research, she has 38 issued patents. She has an extensive technical background encompassing optoelectronic device behavior and characterization, imaging system modeling, optics and optical metrology, image processing circuit design and algorithm development, and in colorimetry, image compression, imaging test standards and image quality metrics. Cynthia earned a B.S. in Electrical Engineering and a B.A. in Mathematics and Computer Science from Gonzaga University, and a Master's degree in Electrical Engineering from the Rochester Institute of Technology. She has received additional training through the Industrial Research Institute, and the MIT Sloan School for R&D Technology Management and is a member of the IEEE, IS&T, SID, and NAPP.

Curtis D. Moyer, *Principal Process Engineer*, is responsible for a-Si TFT on flexible substrate process definition, metrology, the manufacturing execution system (MES) implementation and operation and electrical test development at the Flexible Display Center where he has worked since June 2004. He has over 26 years of manufacturing, research and development, and management experience in areas spanning optoelectronics, RF test, semiconductor processing, OLEDs, FEDs and displays. His work has

included technology project planning, leading cross-functional development teams, semiconductor process modeling and simulation, semiconductor and thick film-based process design, modeling and process development, optoelectronics device modeling and fabrication, RF test, electrostatic field simulation and electron trajectory modeling. He earned a B.S. with honors in Electrical Engineering from the University of Illinois in 1981 and an M.S. in Electrical Engineering from Arizona State University in 1987. Mr. Moyer is Member of the IEEE, and member of the Society for Information Display. He has thirty-five issued U.S. patents and nine publications.

Barry P. O'Brien, *Principal Process Engineer* is responsible for thin-film deposition and related material characterization in the Flexible Display Center, where he has worked since 2004. His main function is the development of low temperature PECVD films for use in TFT backplanes. In addition to his experience at ASU, he has worked on GaAs-based electronic and optoelectronic devices, RF MEMS and displays for other companies such as TRW (now Northrop Grumman), Motorola and several start-up companies. He earned an MS in Materials Science and Engineering and B.S. in Mechanical Engineering from UCLA, and holds one US patent. He is a member of MRS, AVS, SID and IEEE.

Sameer M. Venugopal, Ph.D., *Display Design Engineer*, joined the Flexible Display Center in Feb 2004. He is the principal design specialist responsible for the design, simulation, and layout of active matrix backplanes for Electrophoretic, Cholesteric and OLED displays on flexible substrates. He is also responsible for developing advanced digital circuits using low temperature amorphous silicon thin film transistors. Sameer is the *Project Engineer* for development of high resolution Electrophoretic Displays on flexible stainless steel foils. He has experience in VLSI and Analog circuit design, simulation, layout and test. He has extensive knowledge of semiconductor processing and design concepts for CMOS and amorphous silicon technologies. He conducted 4 years of research on integrating the electronics for displays on flexible substrates and successfully demonstrated electrophoretic displays with integrated drivers. He received his B.S. degree from BMS College of Engineering, Bangalore, India in 2000 and worked as a Software Engineer for a year at Infosys Technologies Ltd. He has worked with ASU since Jan 2002 starting out as a Master's student in Electrical Engineering majoring in Signal Processing and Communication and received his MSE degree in Dec 2003. He earned a Ph.D. in May 2007 for his extensive work on active matrix backplanes and integrated electronics on flexible substrates from Ira A. Fulton School of Engineering at ASU. His research interests include large area electronics and digital circuits fabricated in a-Si:H and organic TFT technology. Sameer is a member of IEEE and Society for Information Display where he serves as a reviewer for refereed publications. He has authored/co-authored over 15 publications and presented his work in internationally recognized conferences in the fields of displays and large area electronics.