

Preface

I was asked by the editors to write a book on molecular electronics that focuses upon the work that has been conducted in my own research. A presentation of one's own work is far simpler to write than a compendium covering the work of the many superb researchers in the field. Although I will make mention of other's work in the context of the research that we have done, no science, at least not chemistry, is done in a perfect vacuum. I am deeply indebted to numerous colleagues around the world for their inspiring discussions and complements with work that far surpasses, in quantity and quality, that of my own. To them I say, thank you 1000 times.

The editors permitted me the liberty to insert some learned experiences regarding startup companies. Those experiences might prove insightful to the prospective founder, corporate officer, or potential investor in the molecular electronics business arena.

My entry into the field of molecular electronics occurred in 1988, at the start of my independent research career in synthetic organic chemistry at the University of South Carolina. I set out with my first graduate students, Jeffrey Schumm and Ruilian Wu, to synthesize the orthogonal switch as proposed by Ari Aviram, who was at IBM at the time. My students and I were blissfully unaware of the steep slopes of challenge that awaited us and the colorful comments that we would be obliged to entertain from concerned colleagues around the world. Their disgruntlement was fundamentally with the basic premise upon which molecular electronics is built, namely, molecules having to perform switching in an addressable array. In 1992 we teamed with Professor Mark Reed of Yale University. Mark's device testing ability, his "can-do" research spirit, his rich background in solid-state physics from his earlier corporate days at Texas Instruments, and his ability to address the sharpest attacks of the critics, became the sustaining grace of our molecular electronics effort. Though unbelievers remained for a time, and some even remain until today, the number of believers and true practitioners of molecular electronics has risen sharply.

With generous federal support, primarily from the Defense Advanced Research Projects Agency (DARPA), the Office of Naval Research (ONR), the Army Research Office (ARO), the National Science Foundation (NSF), the US Dept. of Commerce, National Institute of Standards and Testing (NIST), the

National Aeronautics and Space Administration (NASA), and the early risk-taking willingness by the program directors of those organizations (especially Jane Alexander, Bill Warren, Bruce Gnade, Christie Marrion, and Kwan Kwok of DARPA and John Pazik of ONR), the initial Reed/Tour research team could expand to add numerous complementary scientists who furthered the accomplishments. The team now includes David Allara (surface science) and Paul Weiss (probe microscopy) at Penn State University, Paul Franzon (device engineering) at North Carolina State University, Jorge Seminario (chemical theory) at the University of South Carolina, Patrick Lincoln (computer science) at the Stanford Research Institute, Herb Goronkin, Ray Tsui, and Islamshah Amlani (device physics and engineering) at Motorola Corp., Al Bard at the University of Texas (electronics measurements) and all of their respective research groups. There are many other groups with which we collaborate, a testament at the heart of molecular electronics, namely interdisciplinary research. Most importantly, many portions of this book were derived from collaboratively written works by and with my student and post doctoral associates, primarily: Darren Pearson, LeRoy Jones, II, Jeffrey Schumm, Ruilian Wu, Timothy Burgin, Adam Rawlett, Masatoshi Kozaki, Yuxing Yao, Raymond Jagessar, Shawn Dirk, David Price, Stephanie Chanteau, Dmitry Kosynkin, J. J. Hwang, Michael Stewart, Summer Husband, Christopher Husband, William Van Zandt, Lauren Wilson, Jonathan Daniels, Jay Henderson, and Dustin James. Dustin also helped enormously with the organizing of this book. I also thank Steve Currall, Professor of Business, for his insight and advice through the most trying business situations; he's never yet been incorrect in his counsel.

In summary, although the molecular electronics work I describe in this book is not comprehensive, it will be broad in its scope of covered topics. Specifically, the background, commercial landscape, synthetic chemistry, initial device construction, architecture and programming are covered in a manner to be of aid to the chemist, surface scientist, physicist, engineer, computer scientist, mathematician, investor and the casual reader alike.

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