Afterword

Here, on the level sand,
Between the sea and land,
What shall I build or write
Against the fall of night?

Tell me of runes to grave
That hold the bursting wave,
Or bastions to design
For longer date than mine.

A.E. Housman, from “Smooth Between Sea and Land”

We have come to the end of our long journey of exploration of the role of chemistry in lithography. Our journey has led us to many important destinations that mark the trail of the story of lithography. We started off by exploring the events that led to the invention of lithography, and from there we wandered farther afield in search of its chemical and optical origins. There we discovered a long chain of connected roads, built with physical and chemical ideas and concepts, spanning over 3000 years, stretching all the way back to the Greek era, through the scientific revolutions of the eighteenth and nineteenth centuries, that made possible the invention and development of lithography.

Next, we explored the evolution of lithography into the myriad strands that are practiced today, aided in large part by advancements in chemistry and physics, especially optical physics. In particular, we explored the roles of chemicals in lithographic patterning. We went a step further and explored each major lithographic technology in depth, examining the chemical and physical basis of their imaging mechanisms, and highlighting in the process how each imaging mechanism is made possible by the successful marriage between chemistry and optics. In addition, we examined how lithography is implemented in the fabrication of IC devices, using as an illustrative example the case of a complementary metal-oxide semiconductor device built from a 90-nm technology node inverter. This semiconductor device uses transistors to mediate computational functions in microprocessors used in computers that have done so much to enhance our modern lives. Finally, we examined the main approaches of advanced resist
processing and resolution limit issues of resists in the context of the trade-offs between resolution, line edge roughness, and sensitivity.

I have enjoyed being your guide through this journey. I hope you have enjoyed it as well. If through the course of this book, you, dear reader, have gained a better appreciation of the important role of chemistry in mediating lithography, then the efforts that have gone into writing it have been well worth it.
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