

Transmission Electron Microscopy: Diffraction, Imaging, and Spectrometry

Preface

In the prefaces to the first and second editions of Williams & Carter, we asked the same question: “How is this book different from the many other TEM books on the market?” Our answer was, in essence, that these volumes are true textbooks, written to be studied by undergraduates and graduates, constructed in lecture-size segments and (in the softbound versions) able to be used at the console of the microscope. Perhaps the most distinguishing feature of the books was that, unlike all previous TEM texts, we wrote them as we taught in the classroom: in an informal style, interspersed with side comments and the occasional attempted joke – which rendered translation into other languages too challenging. Around 20,000 hard copies have been printed to date, and hundreds of thousands of chapters have been downloaded.

So why do we need a Companion Volume, and why do we refer to it as the Companion Volume? The answer requires recounting a little history, which, as we’ve indicated in prior prefaces, is something we enjoy. We see this book as filling a need that is really a reflection on what has happened to the TEM field in the decades since Williams first suggested the need for such a book to Carter in the living room of the Carter home in Ithaca, NY, one cold spring morning in 1985, and which is why Carter proposed that it should be W&C. Buoyed by excess coffee (see Section 34.2 of the second edition) we decided to go ahead and write. At first, we decided that a group of four complementary experts could cover the principal aspects of the TEM field at that time (hence the division of the book into four parts). Such a team was assembled. However, we found that textbook writing was not for the faint of heart. Soon after we started putting fingers to the keyboards of our \$2,500(!) Apple Macintoshes and mailing floppy disks to each other containing our initial attempts, we were reduced to just W&C.

Despite our lack of expertise in certain key areas of the TEM field, we managed, by 1996, to complete W&CI. Then, no doubt due to the same excesses of caffeine, we decided in 2003 to rewrite the text, and so W&CII was born in 2009. When starting W&CII we recognized that there was not much in W&CI that we could omit! But it was already a macrotome. We also realized that writing another full book on all the new things that were happening in TEM was not what we had time to do – it would take another 10 years at least. (It did.) So we invited a few of our long-time friends and colleagues who were wonderfully qualified to write particular chapters; the ones whose photos you see in these pages are still our friends, we hope. So the Companion Volume was conceived as a collection of chapters that would be written by world experts on topics that are either perennially important or really new and fascinating, and that we could keep current without sacrificing material in W&C. It may not all be conventional wisdom but we decided that this volume would be CW, or C&W for consistency.

Our own careers have mirrored the rapid evolution of TEM. If you have nothing better to do than read the previous prefaces to our texts, you’ll know that W&C have both evolved from our professorial positions at Lehigh and Cornell back in 1985. We have both taken on roles that required us (like all TEM operators) to broaden our skills and face more challenging responsibilities. We have each moved on to (two) different universities. Our children of the 1970s and 80s are now independent adults with their own twenty-first-century families. Our parents (to whom W&C is dedicated) have all passed on. Yet, particularly important to us, our wives remain with us. Without them, none of this would ever have happened. Thousands of successful TEM students owe their thanks to Bryony and Margie, as do we.

So, taking a leaf out of previous prefaces, we ask anew, why is this Companion Volume different from the many multi-author TEM review texts that are published at regular intervals? First, it builds directly

on W&C, which is extensively referenced throughout. Second, we have taken the high-quality writing of our friends and attempted to give it a W&C flavor, by changing it into informal script where possible. We apologize to all of them when, in doing so, we have destroyed some of their brilliant phraseology. Nevertheless, we believe that, compared to similar texts, we have managed to bring a greater degree of homogeneity to the writings of multiple authors from many different countries. We apologize that a few of the chapters require two or three (or four) lectures and that the 17 chapters will take a full semester to cover. A consequence of this approach is that, except in the About the Authors pages, rather than ascribe individual chapters to individual author(s), we simply acknowledge all our friends up front. If, or when, you are well versed in the TEM field, it should not be difficult to work out who wrote what! Perhaps a good exercise for all you students who are relatively new to TEM would be to search the literature and come to your own conclusions.

We'll mention a few idiosyncrasies that you'll find in the text. One of us has a thing about hyphens and loves Lynne Truss's book about the panda. In spite of this, we have tried to omit all punctuation when writing equations: punctuation is supposed to help, not confuse. We've used our traffic-light boxes again: if it's red, be sure to stop for a moment; if it's amber – you've been warned; if it's green, take note but move on.

While we may not have succeeded in making this Companion Volume as comprehensive and uniform as we made the original W&C editions, we do hope that all you students who enjoyed those first volumes will find this one to be equally valuable. It has been one heck of a ride, and this text is the technical apex of both our professional careers, opening doors that we never dreamed of 30 years ago. TEM continues to grow as a discipline and as an instrument: it is the essential tool for studying nanomaterials. What happens on the nanoscale determines what happens, period, and only the TEM can tell us about structure and composition with accuracy and precision at the nanoscale.

Finally, we thank our friend Sir John Thomas for writing the Foreword to this volume and remember our friend the late Gareth Thomas who wrote the Foreword to W&C.

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