Special Section Guest Editorial: Advances in E-Beam Metrology

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Things are drastically changing in the field of e-beam metrology lately, in response to the daunting specification requirements imposed by the advanced technology nodes in general, as well as by the upcoming introduction of high numerical aperture extreme ultraviolet lithography. E-beam metrology is a quite mature technique, as the first transmission electron microscope (TEM) was invented by Max Knoll in 1931, the first scanning electron microscope (SEM) was developed by Manfred Von Ardenne in 1937, and the first critical dimension SEM (CD-SEM) was created by Hidehito Obayashi in 1984. And as feature sizes in semiconductor manufacturing have shrunk, the capabilities of SEMs have been keeping pace.

Keeping up, however, is getting harder. The spot size of the CD-SEM is shrinking only very slowly, making accurate and precise metrology more challenging. The need for e-beam defect detection is rising with every feature size shrink, putting demands on throughput that were once thought unachievable.

In the last few years, we have noticed a restlessness pervading the field, with e-beam tools used in unconventional and creative ways to solve issues traditionally outside the scope of these tools, as well as new multipurpose e-beam tools being designed and shipped to the fab floors. A variety of new generation e-beam tools are now proliferating in various metrology ecosystems, from in-line TEM to voltage contrast overlay tools, from die-to-database large area inspection to high-voltage SEM, from artificial intelligence-based inspection tools to massive data acquisition e-beam systems.

The papers in this special section represent an interesting and important cross-section of the work going on in this field. As the guest editors we appreciate each of these contributions and thank the authors for their work. As an aside, the observant reader may notice that the two of us are coauthors on a few of these papers. Be assured that the rigorous standards of JM3 have been applied – we were not allowed to serve as editors for our own papers. Instead, those papers were shepherded through the process by other associate editors using the same standards as regular JM3 submissions.

We hope you enjoy these papers – we think they will make a lasting contribution to the continual evolution and advancement of e-beam technology for semiconductor metrology.