Preface

The preceding (May) issue of this journal contains papers devoted to the scientific aspects of electron transport in very small structures (nanostructures). This issue features the technological aspects of fabricating ultrasmall structures, and includes both the evolution and development of lithographic techniques and current research efforts. Together the two issues comprise a compendium of some of the achievements in this exciting and ever-expanding field. The extensive literature cited in the references to the papers in both issues illustrates the high level of interest and the pervasiveness of the work in this field.

The work in nanostructures, as discussed in the preface of the previous issue, was primarily motivated by the compelling need for increased circuit densities and by subsequent cost reduction and improved performance. Secondarily, there was—and is—intense scientific interest in electron-transport phenomena in these very small structures.

The papers in the present issue describe the tools and processes for making devices of nanostructure dimensions. While there are several technologies with which very small structures and circuits can be fabricated, the application of electron-beam lithography techniques has been the most successful. There are two components of electron-beam lithography which must be mutually compatible; namely, a specific resist and an e-beam system for providing the correct exposure are both needed to achieve circuit dimensions within a given size range. The continual increase in circuit densities has furthered an evolution in resist materials and in electron-beam exposure systems. Along with the development of electron-beam-sensitive resist materials capable of high resolution, the electron-beam columns themselves are described both in their basic or simplest configuration and in the advanced computer-controlled lithography systems currently in use in manufacturing and development. Circuits with linewidths less than or approximately equal to ¼ micron and individual lines of much smaller widths are shown throughout and have been studied both for their scientific interest and for applications. Some results from circuit elements, small structures, and fine lines with dimensions of about 15 to 20 nm are also discussed in this issue. These particular experiments are mainly of scientific interest, but may pave the way for new achievements in small structures and devices. Future work holds the promise of even smaller structures and exciting new physics and will be concerned with sub-10-nm lines and sub-100-nm useful circuits.

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The permission by the American Institute of Physics and the American Physical Society to publish in this special issue figures which have previously appeared in their journals is gratefully acknowledged.