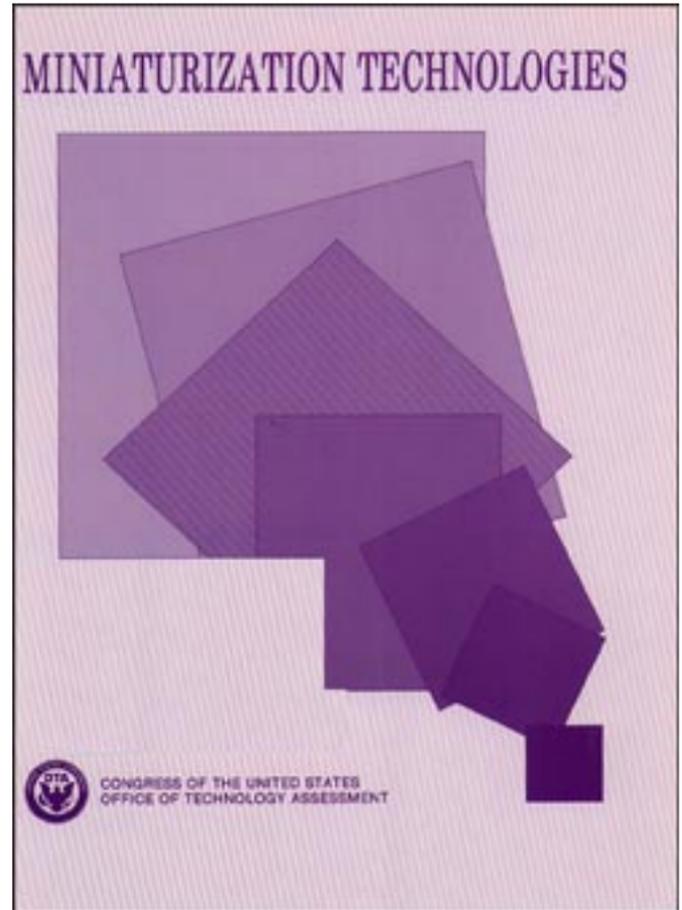


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## Foreword

Advances in miniaturization technologies have had dramatic impacts on our lives. Radios, computers, and telephones that once occupied large volumes now fit in the palm of a hand. Dozens of sensors are sent on spacecraft to the planets and on instruments into the human body. Electronic brains are in everything from bombs to washing machines.

This report analyzes various technologies that may be important for future advances in miniaturization. Current research in the United States and other nations is pushing the limits of miniaturization to the point that structures only hundreds of atoms thick will be commonly manufactured. Researchers studying atomic and molecular interactions are continuing to push the frontiers, creating knowledge needed to continue progress in miniaturization. Scientists and engineers are creating microscopic mechanical structures and biological sensors that will have novel and diverse applications.

OTA characterizes U.S. research and development in miniaturization technologies as the best in the world. Despite the growing prowess of foreign research, American researchers continue to innovate and push the frontiers of miniaturization. The more elusive challenge is to translate success in the laboratory to success in the global marketplace.

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NOTE: OTA appreciates and is grateful for the valuable assistance and thoughtful critiques provided by the workshop participants. The workshop participants do not, however, necessarily approve, disapprove, or endorse this report. OTA assumes full responsibility for the report and the accuracy of its contents.

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