

Foreword

I am happy to bring to you the 2016 Annual Research Report of the Microsystems Technology Laboratories. It highlights the research and educational activities of faculty, staff, students, postdocs and visitors associated with MTL during MIT Fiscal Year 2016.

MTL's mission is to foster world-class research, education and innovation at the nanoscale. Nanoscale science and technology can help solve some of the world's greatest problems in areas of energy, communications, water, health, information and transportation, among others. In all these important areas of human concern, as showcased in this report, researchers at MIT are engineering new materials, structures, devices, circuits and systems using MTL's facilities and services in search of new solutions to persistent problems. MTL's activities encompass integrated circuits, systems, electronic and photonic devices, MEMS, bio-MEMS, molecular devices, nanotechnology, sensors and actuators, to name a few. MTL's research program is highly interdisciplinary. MTL's facilities are open to the entire MIT community and the outside world. Nearly 600 MIT students and postdocs from 21 different Departments, Laboratories or Centers carried out their research in MTL's facilities in the last fiscal year. In addition, researchers from several companies, as well as government research laboratories and domestic and international universities use MTL's facilities annually.

To accomplish its mission, MTL manages a set of experimental facilities in buildings 39 and 24 that host in excess of 150 fabrication and analytical tools. We strive to provide a flexible fabrication environment that is capable of long-flow integrated processes that yield complex devices while, at the same time, presenting low-barrier access to fast prototyping of structures and devices for users with very different levels of experience. Our fabrication capabilities include diffusion, lithography, deposition, etching, packaging and many others. Our lab can handle substrates from odd-shaped small pieces to 6-inch wafers. The range of materials continues to expand well beyond Si and Ge to include III-V compound semiconductors, nitride semiconductors, graphene and other 2D materials, polymers, glass, organics and many others.

MTL also manages an information technology infrastructure that supports state-of-the-art computer-aided design (CAD) tools for device, circuit and system design. Together with a set of relationships with major semiconductor manufacturers, MTL makes available to its community some of the most advanced commercial integrated circuit fabrication processes available in the world today.

MTL could not accomplish its mission without the vision, commitment and generosity of a number of companies that comprise the Microsystems Industrial Group (MIG). The MIG supports the operation of MTL's facilities, and it also advises the faculty on research directions, trends and industrial needs. The list of current MIG members can be found in the "Acknowledgments" section of this report.

In the fall of 2014, we celebrated the 30th anniversary of the creation of MTL. From an initial emphasis on semiconductors and electronics, over now 32 years of life, the technologies that underpin MTL's activities and their domains of application have greatly expanded. The 2016 Annual Report is the broadest in scope to date with abstracts describing research on nanoscale transistors, medical devices, microfluidics, organic lasers and perovskite photovoltaics, among many exciting research projects.

The research activities described in these pages would not be possible without the dedication and passion of the fabrication, IT and administrative staff of MTL. Day in and day out, they strive to support MTL users in the pursuit of their dreams. They do this in a professional and unassuming manner. Their names do not usually end up in the research papers, but that does not diminish the significance of their contributions. To them and to all of you who support in your own way the activities of MTL, a most sincere thank you!

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