

Foreword

I am happy to bring to you the 2017 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 2017.

MTL is predicated on the notion that 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 this regard, MTL's mission is to foster world-class research, education, and innovation at the nanoscale. In all these and other important areas of human concern, as showcased in this report, researchers at MIT are carrying out fundamental research and engineering in materials, structures, devices, circuits and systems using MTL's facilities and CAD 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 23 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 more than 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 small, odd-shaped 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.

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!

Jesús A. del Alamo
Director, Microsystems Technology Laboratories
Donner Professor
Professor of Electrical Engineering
Department of Electrical Engineering and Computer Science
July 2017