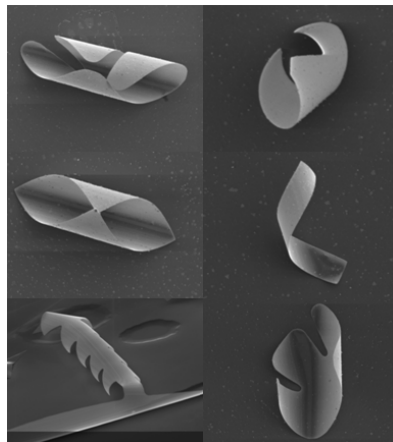




Center for Nanoscale
Chemical-Electrical-Mechanical
Manufacturing Systems

Silicon Nanomembranes

Silicon nanomembranes (SiNMs) are extremely thin (<10 to 100s of nm), flexible, strain-engineered, single-crystal sheets. Their novelty is several-fold: they are flexible, they are readily transferable to other hosts and conform and bond easily, they are stackable, and they can take on a large range of shapes (tubes, spirals, ribbons, wires) via appropriate strain engineering and patterning. They provide the potential for new or enhanced application of Si in fast flexible electronics; quantum electronics, new nanophotonic, optoelectronic, and thermoelectric devices; and chemical and biological sensors. Many properties of bulk Si can be modified in SiNMs, including band structure and quantum properties, electronic transport, phonon distributions, and mechanical properties. Because they are so close, the two surfaces of the membrane become a significant influence on overall SiNM properties. In this talk I review SiNM processing (fabrication, strain engineering, and transfer) and some of the unexpected physical and electronic properties of SiNMs. These include surface transfer doping via surface structures or adsorbed layers, through-membrane elastic interactions to create periodic strain lattices, conduction band splitting and shifting with strain, and orientation-dependent carrier mobility enhancement with strain. Applications will be briefly addressed as time permits.



Max G. Lagally
Department of Materials Science and Engineering
University of Wisconsin-Madison

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1000 Micro and Nanotechnology Laboratory

Max G. Lagally is the Erwin W. Mueller Professor of Materials Science and Physics at the University of Wisconsin-Madison. His research focusses on growth and structure-properties relationships of materials at the nanoscale, primarily semiconductors. He has ~350 publications, has edited four books, and has several patents. He is a member of the U.S. National Academy of Engineering and the German National Academy of Sciences - Leopoldina, and has received numerous other awards. He has founded two companies, nPoint, Inc. and SonoPlot, Inc.