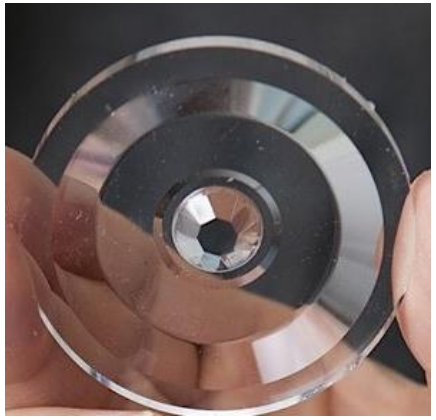
Micromachining and Precision Engineering



Established in 2002 under the leadership of Professor Allen Yi, the research and teaching program in precision engineering is focused on high precision manufacturing processes, particularly optical manufacturing processes (a 3D microlens array utilizing freeform optical surface machined using an ultraprecision diamond macine is shown in the figure).

Precision engineering is defined as the multidisciplinary study and practice of high accuracy enginee ring, metrology, and manufacturing. Precision engineering takes an integrated approach to all subjects related to the research, design, manufacture, performance validation, and application of high precision machine tools, instruments, and components, including fundamental and applied research in manufacturing processes, fabrication technology, and advanced measurement science. The scope includes precision engineered systems, manufacturing methodology, and supporting metrology over the full range of length scales, from atom based nanotechnology and advanced lithographic technology to large scale systems such as optical and radio telescopes.

Areas where precision engineering has a significant role include national security, biomedical research, consumer electronics and scientific exploration. The demand for high quality and high volume products used in both consumer and defense industries relies on production of precision components at an affordable cost. At OSU, the focused research areas include,

- Compression Molding of High Precision Glass Optical Components.
  Compression molding of glass components is becoming a viable precision manufacturing process. As an emerging new technology, it faces technical challenges such as thermal shrinkage, optical property variation due to cooling and high cost of mold making. The aim of this part of research is to seek fundamental understanding of the glass molding process by integrating precision mold making, rheological modeling of glass materials and precision measurements of molded glass optics.
- Freeform Optical Design and Fabrication
  Researches in this area involve design, fabrication, metrology, and assembly of freeform optical elements. The significance of this topic lies in the fact that we are in a largely uncharted area. Freeform in this context is loosely defined as a surface that is not-rotationally symmetric. Freeform optics however is a vigorous scientific and engineering discipline, the development of which is facilitated by advances in computing and fabrication technologies.
- Microoptics and Micromachining
  Ultraprecision machining at meso and micro level is an ideal tool for microdevice (including both optical and non-optical) fabrication. Ultraprecision machining is an ideal process to integrate micro details and macro scale substrates thereby providing a complete system solution. This process is especially important for creating true 3D microstructures where lithography can be difficult to implement. An exciting example is freeform microlenses required for miniature size endoscopes.