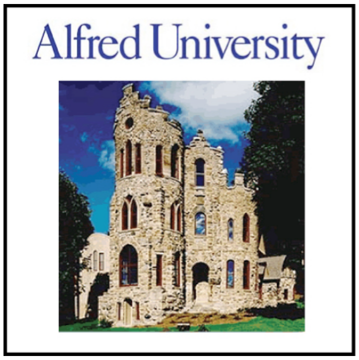

Seminar

"Manipulating Magnetorheological Fluid Properties to Polish Optics"

Kazuo Inamori School of Engineering

Date: Thursday, November 19, 2009

Time: 1:20 PM – 2:10 PM

Location: BMH 108

Prof. Stephen D. Jacobs
University of Rochester

Stephen D. Jacobs received his B.S. in Optics (with high distinction) in 1970, and his Ph.D. in Optics in 1976, both from the University of Rochester. He has worked at the Laboratory for Laser Energetics (LLE) his entire career, becoming a Senior Scientist in 1982. He manages the Department of Optical Technology within the Engineering Division. This department consists of over 35 scientists, engineers and technicians doing basic materials research, advanced development, process development and optics manufacturing. Areas of responsibility in support of the OMEGA and OMEGA EP laser systems include precision optics from the IR through the UV, high power dielectric/sol-gel coatings, laser induced damage, and liquid crystal optics. Dr. Jacobs holds joint appointments as a Professor of Optics (The Institute of Optics), Professor of Chemical Engineering (Department of Chemical Engineering), and Professor of Materials Science (Materials Science Program). He teaches two graduate courses: Optical Fabrication and Testing and Liquid Crystal Optics. He is a Fellow of both the SPIE and OSA.

Dr. Jacobs conducts research in two areas. His work on novel optical finishing processes is currently centered on mechanisms of material removal for Magnetorheololgical Finishing (MRF). His group and an international group of collaborators invented MRF in the mid '90's, and the technology was successfully spun off in the form of a local company, QED Technologies, Inc., in 1997. Dr. Jacobs' work in the field of liquid crystals spans three decades. OMEGA is the only high peak power laser system in the world to use large aperture lc polarizers and wave plates. It contains 300 devices in apertures to 200 mm. Currently his lc group is conducting research on polymer cholesteric liquid crystal flakes for active e-o applications such as electronic paper.

ABSTRACT

Since its invention in the late 90's, Magnetorheological Finishing (MRF) has been adopted by industry for fine polishing of high precision optics. Over 140 computer numerically controlled (CNC) machines have been sold by QED Technologies, Inc. in Rochester, NY (a subsidiary of Cabot Microelectronics Corp., Aurora, Il) and are in use throughout the world. Finishing capabilities extend from 2-mm ϕ parts to 2-m ϕ parts, from flats to aspherics to free-forms, and from glass to crystals and ceramics. For the most part, the MRF process is deterministic, wherein a desired outcome can be predicted and attained. This is not generally the case for conventional optical fabrication, where iteration between processing and testing is normally the case, and where the time to completion of a job cannot be predicted.

Much of the success of MRF is derived from the stability of the MR fluid. This is a very interesting liquid that must meet a unique set of demands. In a magnetic field it must stiffen to support a load, but out of the field it must have a viscosity low enough so that it can be pumped through a circulating system of hoses and nozzles. The active ingredients of an MR fluid are the magnetic carbonyl iron particles and the polishing powder, in a solids concentration approaching 45 vol.%. The carrier fluid for polishing of glass is water, and thus corrosion of the magnetic carbonyl iron particles is an issue.

Recent developments in MR fluids are the subjects of this seminar. How can MR fluids be modified to polish soft polymers or sapphire? How is it possible to polish water soluble crystals? How has the magnetic particle corrosion problem been solved?