Widespread use of lasers will begin to revolutionize industrial processing

by Marsha Freeman

For thousands of years, man has created his machines by striking one piece of metal with another piece of metal shaped as a tool. More recently, he has tempered steel for his tools in huge ovens using large amounts of heat. He has combined one metal with another by means of labor- and energy-intensive alloying to improve the qualities of his tools and implements.

All of this can now be done with lasers.

The March 23 announcement by President Reagan that the United States will embark on a high-technology research and development effort to produce directed-energy beam weapons for defense of the nation means that improved laser and other directed-energy beams will be available for civilian industrial use.

Lasers are already used on a small scale in materials processing industries. But lasers, which can perform almost every function of machine tools, ovens, and furnaces more precisely and economically, could transform modern industry.

Because lasers can be used to drill holes holes that are smaller, rounder, and cleaner than any competing process in a great variety of materials, they are used on plastics to make cardiovascular catheters and irrigation tubing, on rubber to make baby bottle nipples, and on glass for surgical tubing. Lasers are also used to cut molds in wood, perforate cigarette paper, and cut holes in ceramics and cloth.

Greater use of laser systems in the basic metals processing industries holds the greatest promise for developing manufacturing industries in the near future. The large-scale introduction of lasers will mean large increases in productivity in the machine tool and machinery industries, a development that will transform productive capacity in the entire economy, which is dependent on these basic capital goods industries.

To weld metals, a quick pulse of high-energy laser heat is used to form a plasma of metal vapor above the laser spot; the metal is then cooled to bind the materials. The Illinois Institute of Technology (IIT Research Institute) has found that laser welding uses only two-thirds the energy of currently-used electric arc welding, and can weld an order of magnitude faster at one eighth the total cost.

Lasers are also currently in use for heat treating and hardening metals, and for alloying particularly hard or non-corrosive materials with basic carbon steel. This process economizes on the use of expensive alloying metals and, because it is possible to harden only one portion of a piece of metal, using lasers means that it will no longer be necessary to heat-harden the entire metal piece in a large furnace.

Cheaper laser systems will make this technology available to an even wider array of industrial companies. Smaller machine tool and machinery producers, who make up the bulk of machine manufacturers in the United States, will be able to integrate laser technology into their operations.

Flexible manufacturing

The most exciting potential application of laser systems will be in the development of "flexible manufaturing," in which the multi-purpose laser is wedded to the robot; the human operator no longer moves parts around the factory, but manages a high-technology sequence of operations.

At IIT's Research Institute in Illinois, a test center is in operation to evaluate laser-robot combinations. According to Fred Seaman, the manager of the center, their experimental test cell can make four different parts with only a change in computer commands. Machines do not have to be re-set by human operators—the computer tells the laser how to cut, drill, machine, harden, or alloy the particular part.

Seaman points out that this laser-computer-robotics combination could potentially do 80 percent of all metal-related manufacturing!

U.S. laser experts also report that the Mitsubishi Electric and Fuji Tool Companies in Japan are making flexible manufacturing systems, and that the total Japanese research and development commitment in this promising field is about $60 million per year.

Future flexible manufacturing centers will be made up of banks of lasers, robotic systems to make any necessary movements around the plant, and computers which supervise the process. Skilled operators will supervise the computers and repair the systems as necessary.