Abstract

LASER SURFACE MODIFICATION OF TOOL STEELS FOR ENHANCING SURFACE PROPERTIES

by Leong Ka Ip

Thesis Supervisor: Dr. Kwok Chi Tat

Department of Electromechanical Engineering

Laser surface melting and laser transformation hardening of various tool steels namely plastic mold steel, high speed steels and working steels, were achieved by a CW Nd:YAG laser. The microstructure and the phases present in the melt zone and heat-affected zone of the surface of specimens after laser treatment were analyzed by optical microscopy, scanning electron microscopy and X-ray diffractometry. The surface hardness of the specimens was also measured by a Vickers microhardness tester. The corrosion characteristics of the laser-treated steels in 3.5 wt% NaCl solution at 23°C were studied by potentiodynamic polarization technique.

The microstructures of the laser-treated surface are changed completely after laser surface treatment. In the case of laser surface melting, some specimens show improved corrosion resistance by the dissolution of alloy elements in the solid solution without degrading the surface hardness compared with the conventionally hardened specimens. The hardness and corrosion characteristics of all the laser-treated specimens are strongly dependent on the scanning speed and power density of the laser beam, which in turn result in different microstructures.