A Sacrificial Mercury Mirror for Laser Eye and Sensor Protection

Timothy Pritchett

Sensors and Electron Devices Directorate
U.S. Army Research Laboratory
Adelphi, Maryland

ABSTRACT:

With the proliferation of lasers on the modern battlefield, it has become increasingly important to develop a device capable of protecting both the human eye and electronic sensors from the damage the may result from intense laser beams. One concept for such a device involves a "sacrificial" mirror situated at a focal plane. Damaging radiation, focused to a small spot on the mirror, would rapidly vaporize the irradiated region of the mirror and thereby limit the reflected energy to an amount insufficient to cause damage. In the mid-1970s, optical limiting devices employing sacrificial mirrors were demonstrated to provide effective protection from microsecond-pulsed lasers as well as from continuous-wave sources. More recently, the broad spectral range intrinsic to sacrificial mirror limiters has stimulated renewed interest in these devices to counter the emerging threat from frequency-agile sources with nanosecond and picosecond pulse widths. I first present a simple, thermodynamic model for a purely ablative sacrificial mirror and use the model evaluate a number of alternative mirror designs. I then describe a more detailed model that takes into account the time dependence of the ablation process in a mercury mirror. I compare the actual optical limiting performance of such a mirror measured with that predicted by the model.

KEY WORDS: limiting mirror, sacrificial mirror, laser eye protection

CONTACT: Timothy Pritchett, PhD, ARL, Adelphi, MD 20783
Tel: (301) 394-0332 email: tpritchett@arl.army.mil