Laser Induced Damage of reflective metal mirrors in IFE systems limits the lifetime and acceptable laser power density on targets for economic power plant operation. For a single pulse with normal incidence of on highly polished Al or Cu metal mirrors, the Laser Induced Damage Threshold (LIDT) is only \( \approx 0.2 \) J/cm\(^2\) for Al, and a few J/cm\(^2\) for Cu. This damage threshold is further degraded by repeated pulsed laser interaction with the metal's surface. We present here theoretical and experimental results for the dependence of LIDT on the characteristics of both laser energy and material properties. We present data that characterizes damage mechanisms and demonstrates the improvement and stability of operation at grazing incidence angles. A model for the generation of surface deformation ripples is then introduced and also compared to experiments on impurity-free metallic surfaces. It is shown that the generation of near surface lattice defects (e.g. vacancies) results in mechanical contraction of the top surface layers, which leads to an instability of the flat surface. Coupling between the elastic and diffusion fields of surface defects is associated with spinodal-like vacancy diffusion, thus generating regions of inhomogeneous, yet regular surface deformation. Non-linear saturation of this type of mechanical instability will be shown to result in spectacular deformation patterns that are consistent with experimental observations. The implications of surface deformation ripples on the focusing quality of reflective mirrors in IFE systems will also be critically assessed.