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Tailoring nanostructured targets for enhanced high-power laser-solid interaction

Nanostructured targets can enhance the laser-matter interaction by coupling the laser pulse into the target, by volumetric heating, due to the increased surface area, leading to higher proton energy cut-off, yield, X-ray or gamma ray emission, and terabar pressure. However, enhanced coupling is highly dependent on the correlation of the target parameters to the laser pulse characteristics (as laser contrast, wavelength, and pulse duration) therefore, the diameter and gap between the structures, along with their height and substrate thickness, were controlled through the fabrication methods. Highly ordered metallic (gold and nickel) nanowires and nanotubes on thin substrates, have been used as targets for proton acceleration and x-ray emission studies, and have been irradiated by 1 PW, ultra-short laser pulse, with an intensity of 10^{21} W/cm^2 , using a single plasma mirror system for pulse cleaning. Radiochromic film stacks and Thompson parabola have been employed as ion diagnostics and CsI scintillators for electron and photon signal. An enhancement in the proton yield and in the photon signal, from the nanostructured targets is discussed and presented, comparative with flat targets.

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