Laser Light Reflection from Nanowire Arrays

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The interactions of ultra-intense lasers with nanowires received a lot of attention as they appear to show potentials to increase the laser light absorption. This leads to an increased yield in the production of accelerated particle for variety of applications. However, the nanowire array are sensitive to the laser pre-pulses and could potentially form a pre-plasma with critical density resembling the flat solid target when interacts with the pre-pulses. This will affect the laser absorption. Here, we demonstrate via combine radiation hydrodynamic and particle-in-cell simulation how the laser light is reflected and absorbed. We use the measured laser temporal profile from 1 PW laser system at ELI-NP to simulate the interactions of laser pre-pulses with nanowire target. The Amplified Spontaneous Emission (ASE) contrast used in the simulation is at the level of 10^11 with main pulse peak intensity of 10^22 W/cm2. The tip of the nanowire undergoes the implosion by the rocket-like propulsion of the ablated plasma when irradiated by 250 ps ASE with the intensity of 10^11 W/cm2. This implosion cause the nanowire to deform and the damage increases with a longer ASE duration. At the same time, the pre-plasma with critical density is formed in front of the nanowire. The exact nanowire target density profile is then transferred to the particle-in-cell code to simulate the interaction with the main laser pulse. We will discuss the reflection of the main pulse as compared to the flat solid target. With the formation of critical density pre-plasma and the deformation of the nanowire target, we will also discuss the possibility of other interactions that are relevant to the nanowire array, such as z-pinch and high-pressure generation. These understandings offer information for the experimental design for the interaction of nanowire array with high-power laser pulse.