# Optical Probing of Ultrafast Laser-Induced Transitions from Solid to Overdense Plasma

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Capturing the target behavior during a high-intensity laser-solid interaction is crucial to understanding the interplay of fundamental processes such as ionization and plasma kinetics. Moreover, predicting and controlling the pre-plasma evolution produced by the laser rising edge is key for enhancing, for instance, the laser-driven ion beam quality [1]. By monitoring the dynamics of the initial stage of the interaction, we report on a detailed visualization of the pre-plasma evolution. Nanometer-thin diamond-like carbon foils are shown to transition from solid to plasma during the laser rising edge with intensities $I \leq 10^{16}$ W/cm$^2$. Single-shot near-infrared broadband probe pulse [2] transmission measurements evidence sub-picosecond dynamics of an expanding plasma with densities above $10^{23}$ cm$^{-3}$ (about 100 times the critical plasma density). The unique complementarity of a solid-state interaction model and a kinetic plasma description using the SMILEI PIC code provides deep insight into the interplay of initial ionization, collisions, and expansion [3].

## References

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