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Measurement of transient optical phase as a diagnostics technique for XUV pump –optical probe experiments

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Measurement of transient optical properties (reflectivity and transmissivity) is routinely performed in extreme-ultraviolet (XUV) pump –optical probe experiments. The optical properties reflect the transient state of the irradiated materials. Here we propose to extend the material diagnostics with an additional measurement of the transient phase change of the optical probe pulse. It can be recorded in parallel to other transient optical properties, enabling access to full information on the complex refractive index and the thickness of the radiation-modified material layer. The latter is essential for investigations of phase transitions progressing in XUV (and X-ray) irradiated materials.

Here we report on the computational study of XUV irradiated silicon and diamond performed in [1]. It shows that the measurement of the optical phase from a probe pulse at correctly tuned pulse parameters can provide a signal strong enough to extract information on transient material properties. The results suggest that in some cases, it is even more preferable to measure the transient phase change than other optical parameters. Such phase measurement, feasible with modern experimental setups, can then be a basis for an improved diagnostics tool for the temporal characteristics of an ultrashort XUV pulse.

[1] V. Tkachenko et al., Optics Letters Vol. 45, 33-36 (2020).

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