Directly observing ultrafast melting kinetics induced by femtosecond laser pulses with extreme lights

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Intense femtosecond-laser pulses drive material phase transitions via kinetic reactions otherwise hidden in equilibrium measurements, which stimulates a strong interest in revealing the reaction dynamics of individual atoms prompted by photo-depleted bonding electrons. However, the field of ultrafast atomic dynamics has been limited by the challenges involved in resolving the accompanying irreversible processes at the relevant space–time resolution. By establishing single-pulse time-resolved experimental technique using an X-ray free-electron laser, we overcome this to directly observe the kinetic processes accompanied during the nonequilibrium phase transitions. In this talk, we will introduce recent experimental observations of exotic melting reaction forbidden in thermodynamic (near) equilibrium condition together with physical interpretation guided by the two-temperature molecular dynamics.

Acknowledgements:
This work is supported by National Research Foundation of Korea (Grant Nos. RS-2022-NR068223 and RS-2024-00346711).

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