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Formation of Nanostructures at Gold Surfaces Exposed to Femtosecond Laser Pulses KELSIE NIFFENEGGER, Auburn University, BRIAN DEMASKE, VASILY ZHAKHOVSKY, IVAN OLEYNIK, University of South Florida — The evolution of free-standing gold film irradiated by ultrashort laser pulses was simulated using molecular dynamics. The spatially non-uniform deposition of laser energy was modeled by a two-dimensional temperature profile applied during time of electron-ion energy exchange. Our simulations show that the ultrafast two-dimensional heating results in the melting and pressurization of a thin surface layer. Due to a non-uniform stress distribution, this molten layer expands to form a jet-like protrusion at the laser pulse's focal point. Above some critical stress, many voids start to nucleate forming a foam-like material covered by a thin liquid shell/cupola. The still expanding cupola may rupture forming a rim around the newly-developed crater. All these processes lead to complicated surface morphology, which becomes frozen at the nanosecond time scale. Geometrical characteristics of simulated surface profiles, including crater depth and size of frozen bubbles, agree well with experiment. Our simulations help to provide better insight into the atomistic mechanisms of nanostructure formation.

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