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Controlling Material Transformation and Plasma Emission with Trains of Ultrafast Laser Pulses ROBERT J. GORDON, SIMA SINGHA, University of Illinois at Chicago, ZHAN HU, Jilin University — Trains of ultrafast laser pulses, generated by passing a 50 fs, 800 nm Ti:Sapphire pulse through a spatial light modulator, were used to ablate GaAs in air. The wavelength-resolved plasma emission was measured as a function of pulse spacing and fluence. For a pair of pulses, the plasma emission increased monotonically with spacing, with the fluorescence enhancement described by $A(1 - e^{-t/\tau})$, where t is the pulse spacing and $\tau =$ 46 ps, at a total fluence of 12.3 J/cm^2. This behavior is explained by a mechanism in which the first pulse melts the surface and the second pulse interacts with the liquid phase, while the melt front propagates into the crystal (1, 2). Much more complex time and energy behavior was observed for a three-pulse train. The fluorescence enhancement at 450.8 nm displayed peaks at pulse spacings that correspond roughly to multiples of the LO phonon period of the crystal. This behavior suggests a mechanism involving coherent excitation of the crystal by the pulse train.

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[2] S. Singha, Z. Hu, and R. J. Gordon, J. Appl. Phys. 104, 113520 (2008).

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