Formation of multiscale surface structures on nickel via above surface growth and below surface growth mechanisms using femtosecond laser pulses

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Abstract: The formation of self-organized micro- and nano-structured surfaces on nickel via both above surface growth (ASG) and below surface growth (BSG) mechanisms using femtosecond laser pulse illumination is reported. Detailed stepped growth experiments demonstrate that conical mound-shaped surface structure development is characterized by a balance of growth mechanisms including scattering from surface structures and geometric effects causing preferential ablation of the valleys, flow of the surface melt, and redeposition of ablated material; all of which are influenced by the laser fluence and the number of laser shots on the sample. BSG-mound formation is dominated by scattering, while ASG-mound formation is dominated by material flow and redeposition. This is the first demonstration to our knowledge of the use of femtosecond laser pulses to fabricate metallic surface structures that rise above the original surface. These results are useful in understanding the details of multi-pulse femtosecond laser interaction with metals.

OCIS codes: (320.2250) Femtosecond phenomena; (140.3390) Laser materials processing; (240.5770) Roughness.

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