

# Femtosecond laser nano-patterning of Ni/Ti multilayers

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## Abstract

Laser Induced Periodic Surface Structures (LIPSS) are ripples formed due to the spatial periodic energy distribution on the surface originated by the interference of the incident laser light with the excited surface plasmon polaritons at laser fluences slightly above the single-pulse ablation threshold. Low-Spatial Frequency LIPSS (LSFL), with a period of the same order of magnitude of the radiation wavelength can be produced by laser direct writing and a few hundred laser pulses per surface spot [1]. They have a remarkable influence on important physical and chemical surface properties and may find use for various applications [2]. Thin films of Ni/Ti nano-multilayers exhibit a spontaneous self-sustained exothermic reaction when subjected to an external heat source in appropriate conditions, which transforms the multilayer structure into NiTi intermetallic compound through all the film. Due to the aforementioned radiation intensity modulation caused by the interference process, a nano-pattern temperature modulation appears at the surface.

Ni/Ti multilayers with different modulation periods (thickness of one layer of Nickel and one layer of Titanium) of 11 and 25 nm were irradiated using a Yb:KYW chirped-pulse-regenerative amplification laser system (560 fs, 1030 nm) with parameters leading to the formation of LIPSS. These structures were morphologically characterized using SEM and AFM revealing the formation of a typical LIPSS pattern. A layer of NiTi existed at the top of the ripples resulting from the thermally activated  $\text{Ti}+\text{Ni}\rightarrow\text{NiTi}$  reaction at the minima of the energy modulation. The phase composition of the formed structures was also analysed by XRD.

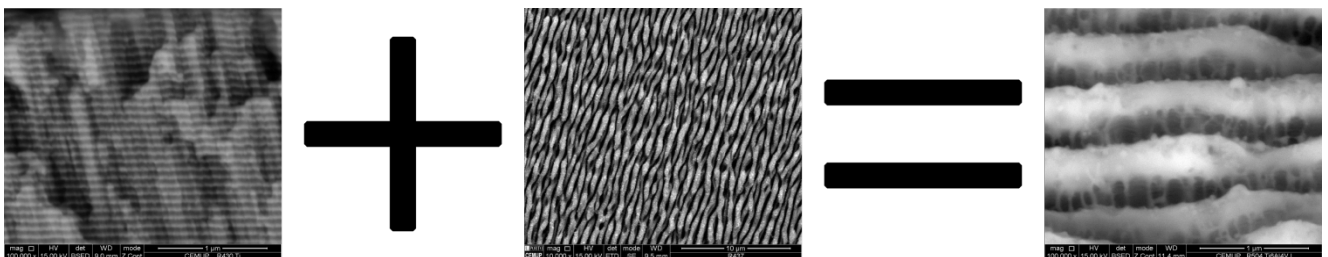


Figure 1. Ni/Ti multilayer + LIPSS surface = LIPSS structure with Ni/Ti multilayers on the bottom and NiTi structure on the top

## Bibliography

[1] Anatoliy Y. Vorobyev and Chunlei Guo, "Direct femtosecond laser surface nano/microstructuring and its applications", *Laser Photonics Rev.* 7, No. 3, 385–407 (2013)

[2] D. Peruško, S. Petrović, J. Kovač, Z. Stojanović, M. Panjan, M. Obradović, M. Milosavljević, "Laser-induced formation of intermetallics in multilayered Al/Ti nano-structures", *Journal of Materials Science* 47.10 (2012): 4488-4495