Basic Research of Intrinsic, Tamper-Indication Markings and Patterns Defined by Pulsed Laser Irradiation

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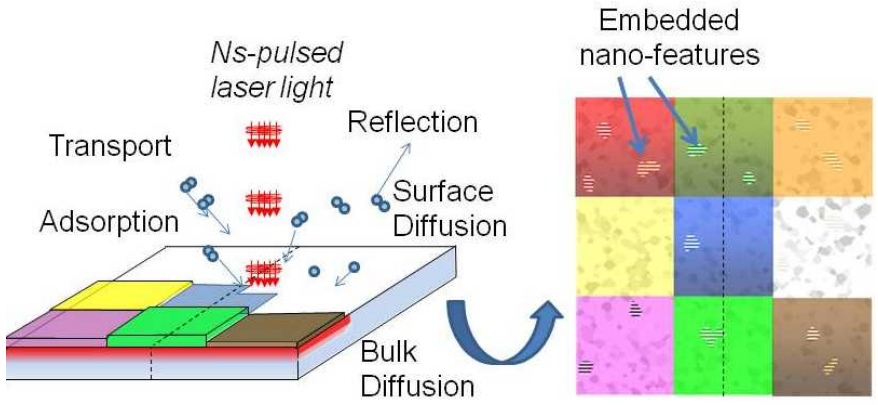
Objective:
We will research how short and ultra-short laser pulses interact with the surfaces of various materials to create complex color layers and morphological patterns.

Relevance: Research will lead to novel methods for creating unique, passive indicators of interference (markings) that assist in monitoring compliance and regulating arms control. We seek markings that should be virtually impossible to duplicate or replicate.



Approach:
Investigate the basic physical and chemical processes underlying the formation of site-selective color patterns and surface morphological features during pulsed laser irradiation. Studies include embedding micro/ nano-scale morphology inside macro-scale color layers.

Personnel Support:
1 Tech. Staff (Sandia Labs) as PI
2 Tech. Staff (Sandia Labs) as co-PI
2 Graduate students (Univ. Michigan, Wash. State)

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Results this year:
- Demonstrated controlled laser color marking of additional materials (e.g., dual phase steel).
- Completed investigation of phase, composition, microstructure, thickness, optical properties.
- Researched mechanical properties (toughness, friction) of laser-defined oxides on steel, Ti.
- Investigated the topographical origin of ripple patterns formed during ultrafast laser irradiation.
- Completed thermal modeling of scanned, pulsed beam incident on representative substrate.
- 8 presentations (1 invited), 4 Publications, 1 Patent Application.

Funding:
FY11-$349k, FY12-$350k, FY13-$350k, FY14-$350K