# Cleaning Chinese bronze with pulsed laser: application examples and tentative mechanistic studies at the Shanghai Museum

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**Abstract** The studies conducted at the Shanghai Museum demonstrated the promising application of the pulsed Nd:YAG 1064nm laser for the challenging bronze cleaning tasks that are difficult to address with conventional methods. Specifically, this laser is effective for: 1) removing thin corrosion from substrates prone to abrasion, such as Chinese mirrors with particular patina and gilt bronze; 2) removing pitting corrosion without causing further surface loss; 3) addressing complex degradation products resulting from past intervention, which are usually insoluble in non-aggressive solvents; and 4) cleaning surface with complicated morphology, such as the typical delicate reliefs on Chinese bronzes[1]. This work reports successful application examples on various bronze objects and optimization methods, including the adjustment of working parameters, the use of gel mediums during cleaning, the combination of laser with other cleaning techniques, and the flexible manipulation of the laser handpiece [2-3]. Mechanistic studies were conducted on expendable bronze fragments and mock-up samples to investigate the laser-material interaction. Preliminary findings indicate that, in addition to composition, the consistency of corrosion significantly influences the process. The spallation mechanism, distinct from the selective vaporization commonly dominating the stone material cleaning, requires careful consideration for operational safety while suggesting broader application potential.

**Keywords** bronze, cleaning, pulsed laser

## Reference

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