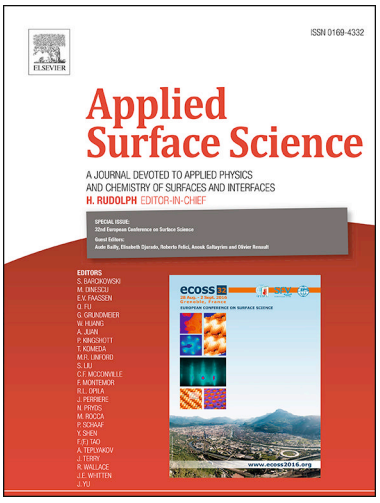
Accepted Manuscript



Full Length Article

Ultraviolet laser-induced damage of freestanding silica nanoparticle films

Fangting Chi, Ning Pan, Congcong Ding, Xiaoqiang Wang, Facheng Yi, Xiaofeng Li, Jiehong Lei

PII: S0169-4332(18)32389-4
DOI: https://doi.org/10.1016/j.apsusc.2018.08.243
Reference: APSUSC 40280

To appear in: *Applied Surface Science*

Received Date: 10 June 2018
Revised Date: 29 July 2018
Accepted Date: 27 August 2018

Please cite this article as: F. Chi, N. Pan, C. Ding, X. Wang, F. Yi, X. Li, J. Lei, Ultraviolet laser-induced damage of freestanding silica nanoparticle films, *Applied Surface Science* (2018), doi: https://doi.org/10.1016/j.apsusc.2018.08.243

Ultraviolet laser-induced damage of freestanding silica nanoparticle films

Fangting Chi [a, b, *], Ning Pan [a], Congcong Ding [a], Xiaoqiang Wang [a], Facheng Yi [a, b], Xiaofeng Li [d], Jiehong Lei [c,*]

[a] Fundamental Science on Nuclear Wastes and Environmental Safety Laboratory, Southwest University of Science and Technology, Mianyang, 621010, China

[b] Sichuan Civil-military Integration Institute, Southwest University of Science and Technology, Mianyang, 621010, China

[c] College of Physics and Space Science, China West Normal University, Nanchong 637009, China

[d] Hazardous Chemicals Quality Supervision and Inspection Institute of Sichuan Province, Chengdu, 610021, China

Abstract

Silica nanoparticle antireflection films are essential for the development of high-power laser systems because of their high laser damage threshold in ultraviolet (e.g., 351 nm or 355 nm). However, most laser damage reports focus on the films standing on substrates, and the intrinsic laser damage behaviors of the silica nanoparticle films are poorly understood due to the influence of the substrates. Here, we investigate the ultraviolet laser damage behaviors of the freestanding silica nanoparticle films. We find that silica nanoparitcle films demonstrate higher laser damage threshold than the fused silica substrates under the irradiation of 355-nm laser. For the films on the fused silica substrates, the laser damage is caused by the substrates. In the case of freestanding films, laser-damage resistance is strongly dependent on the film thickness and the amount of organic groups in the films. The laser damage threshold increases from 103 to 159 J/cm^2 @ 355 nm with decreasing the film thickness from 322 to 31 nm. In addition, removal of organic groups from the films results in higher laser damage threshold. Our findings provide insight into the laser damage behavior of the silica nanoparticle films and foreshow a possible way to improve the laser-damage resistance.

* Corresponding author.

E-mail address: chifangting@163.com (F. Chi) and jiehonglei@126.com (J. Lei).