nanoAR - applications of biomimetic nanostructures

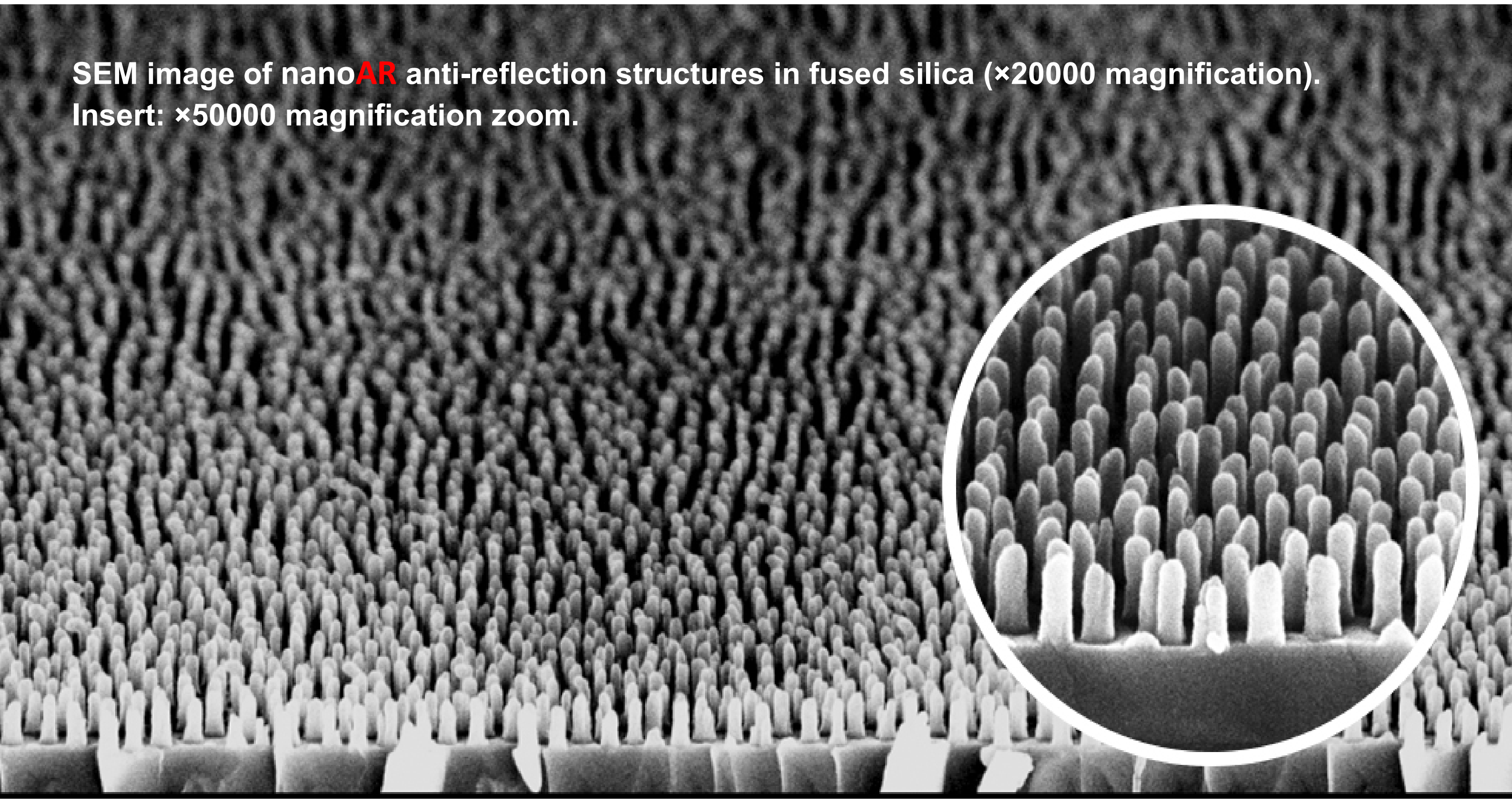
Optical components play an important part in many modern devices, ranging from miniature cameras to mobile phones and medical applications such as endoscopes to high-performance optical sensors of ever-decreasing size in industry and robotics.

Problem statement

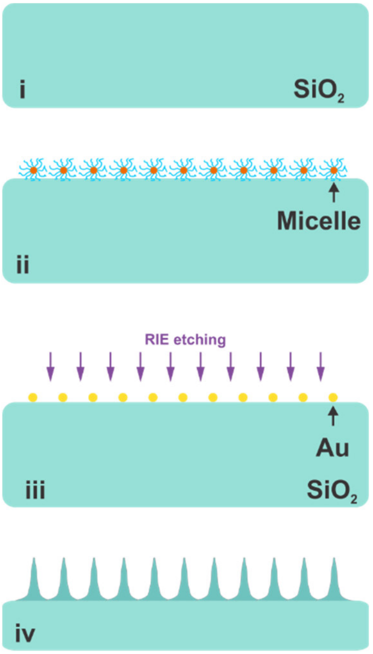
In all optical applications, the commonly occurring yet detrimental reflection of light is still a problem. These reflections make images appear darker, interfere with the optical path, produce "ghosting" and can even seriously damage devices in certain laser applications. In order to reduce these undesirable reflections, so-called anti-reflective coatings have generally been used up to now. These very thin layers of special materials are however only effective within very small wavelength ranges and also have a relatively low mechanical strength and durability.

Problem solving – learning from nature

Some insects have had the solution to this problem for millions of years. On the surface of a moth's eyes for example, miniscule, conical nanostructures ensure an almost complete absence of reflection.


SEM image of nanoAR anti-reflection structures in fused silica (×20000 magnification). Insert: ×50000 magnification zoom.

nanoAR - process for nanostructured anti-reflection coatings of surfaces



Substrate cleaning

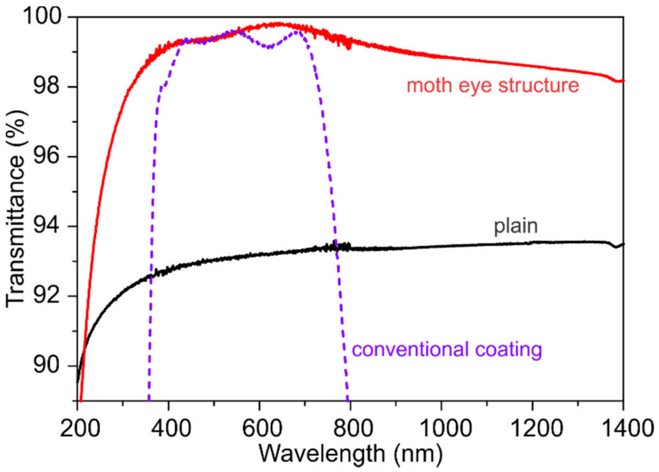
BCML nanopatterning

Plasma treatment

Dry etching

with without
nanoAR

The newly-developed **nanoAR** process makes affordable production on a large scale possible. Applications include high power laser systems, optical sensing systems, touchscreen displays and devices, spectroscopy systems, potential stealth applications, light extraction and light harvesting devices.



Transmittance **nanoAR** versus conventional coating

Red curve: Transmittance of nanopillars in fused silica (spacing 100 nm, height 450 nm). The maximum is 99.8% at wavelength 700 nm.
Dashed curve: Transmittance of conventional multilayer broadband AR coating on the same substrate. The operation wavelength band is narrower and the maximal transmittance is lower than **nanoAR** structurers.

The **nanoAR** technology was developed at the Max-Planck-Institute for Medical Research and the Max-Planck-Institute for Intelligent Systems. The **nanoAR** research is funded by the Max-Planck-Society and the German Ministry of Education and Research. Patents and patents pending.

Literature

Z Diao, M Kraus, R Brunner, JH Dirks, JP Spatz, “Nanostructured Stealth Surfaces for Visible and Near-Infrared Light,” Nano Lett., 2016, 16 (10), pp 6610–6616.
http://www.is.mpg.de/16163983/news_publication_10789612?c=2472

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