Nanotech-nology

Forming technique of Moth-eye structure with high-hardness and anti-fouling effect

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Purpose of Research

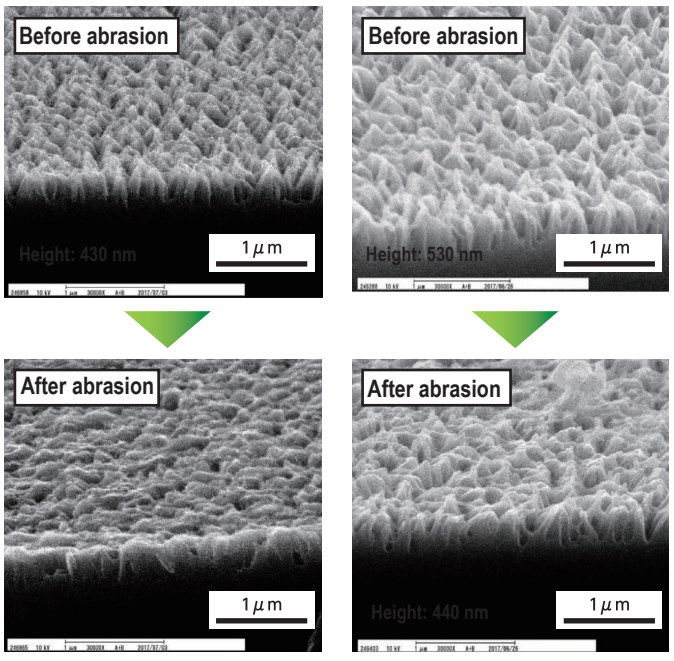
Because the moth-eye structure is nanometer-scale fine, it has the disadvantage that it is easy to break when its surface is touched by a finger, and that fingerprints are hard to wipe off. This research has been aiming to solve this problem and make the moth-eye structure usable for touch panels and other similar applications.

Summary of Research

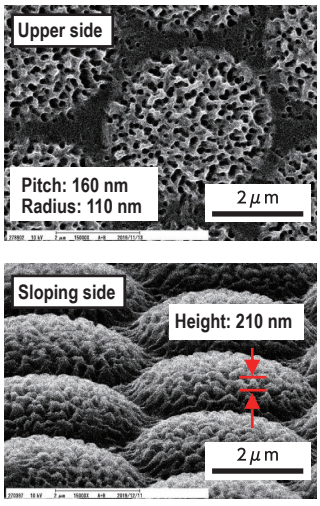
Simply irradiating a glassy carbon (GC) substrate with an oxygen ion beam can form a moth-eye structure (patent registered). The moth-eye structure comprises nanometer-scale needles, which reduce reflected light in the visible wavelength range. This nanostructure, however, has such low strength that it is usually vulnerable to the touch of a finger. The newly developed technique transfers the moth-eye structure on a GC substrate to a special UV-curing resin surface to obtain such high strength that touching it does not damage the structure. In addition, this UV-curing resin contains anti-fouling components that make it possible to wipe off substances such as fingerprints. Because this resin is transparent and has a moth-eye structure, it improves visibility in addition to having an anti-reflective effect. Furthermore, we have developed a technique to form this moth-eye structure on a microlens array, making it possible to configure a microlens array with a reflectivity of 0.6% and a water contact angle of 147°.

<Friction durability>

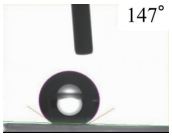
Conventional structure | Newly developed structure



<Formation on a curved surface>



<Water contact angle>



Contact angle: 147°

Newly developed moth-eye film

Comparison with Conventional or Competitive Technologies

- Touching the structure with a finger does not break it. Substances such as oil attached by touch can be wiped off. Has an anti-reflective effect.
- The reflectivity is less than 0.3% in the visible range. Attached synthetic sweat can be wiped off.
- Can be also formed on a curved surface such as a lens.

Expected Applications

- Protection of touch-panel surfaces
- Protection of the surfaces of mobile devices such as smartphones and tablet PCs, and their visibility-improving films
- Visibility improvement of displays and similar surfaces, prevention of reflection off solar cell surfaces, and similar applications
- Applying antireflective, antifouling, and water-repellent properties to optical components such as lenses

Challenges in Implementation

Currently, the maximum moldable size is 50 × 75 mm. For larger areas, multiple molds have to be connected, which requires eliminating traces of junctures.

What We Expect from Companies

- Application of moth-eye films to products
- Further improvement of moth-eye films

We are looking for companies to conduct joint research on these topics.

Points

- **Moth-eye structured films with high strength, anti-fouling characteristics, and low reflectivity**
- **Mass-production feasible by a nano-imprinting technology**
- **Technique can also apply the moth-eye structure to curved surfaces**

Future Developments

We will conduct R&D on creating large-area moth-eye films.

- Associated System: JST A-STEP "High-risk Challenge" type
- Intellectual Property: Japanese Patent Application No. 2007-208624 "Anti-reflection structure body, method of producing the same and method of producing optical member"
- Prototype: Present
- Sample: Available

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