Nanophotonic fabrication based on dressed-photon and phonon

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A reduction of the surface roughness is required in various applications including electronic devices and optical devices. The value of the surface roughness R_a is formally defined as the arithmetic average of the absolute values of the surface height deviations from the best-fitting plane. Although chemical-mechanical polishing (CMP) has been used to flatten the surfaces, it is generally limited to reducing R_a to about 2 Å because the polishing pad roughness is as large as 10 μm, and the polishing-particle diameters in the slurry are as large as 100 nm. We therefore developed a new polishing method, dressed-photon and phonon etching (DPP etching) [1], that uses dressed photon based on an autonomous phonon-assisted process. DPP etching does not use any polishing pad, with which we obtained ultra-flat silica surface with angstrom-scale average roughness as small as R_a of 0.1 nm [2]. We realized reduction of R_a for various structures and substrates, including glass, PMMA, Si, GaN, SiC, and diamond [3], because DPP etching based on photochemical reaction. This technique is a non-contact method without a polishing pad, thus it can be applied not only to flat substrates but also to three-dimensional substrates [5] that have convex or concave surfaces, such as micro-lenses, optical-disk, and the inner wall surface of cylinders. Furthermore, this method is also compatible with mass-production. Using a non-contact method, *in situ* real-time monitoring of surface roughness during DPP etching by measuring the scattered light intensity was realized [4].

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Reference

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