

Robust light beam diffractive shaping based on a kind of compact all-optical neural network: supplement

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S1. The process and details of the fabrication for GS-based phase plate

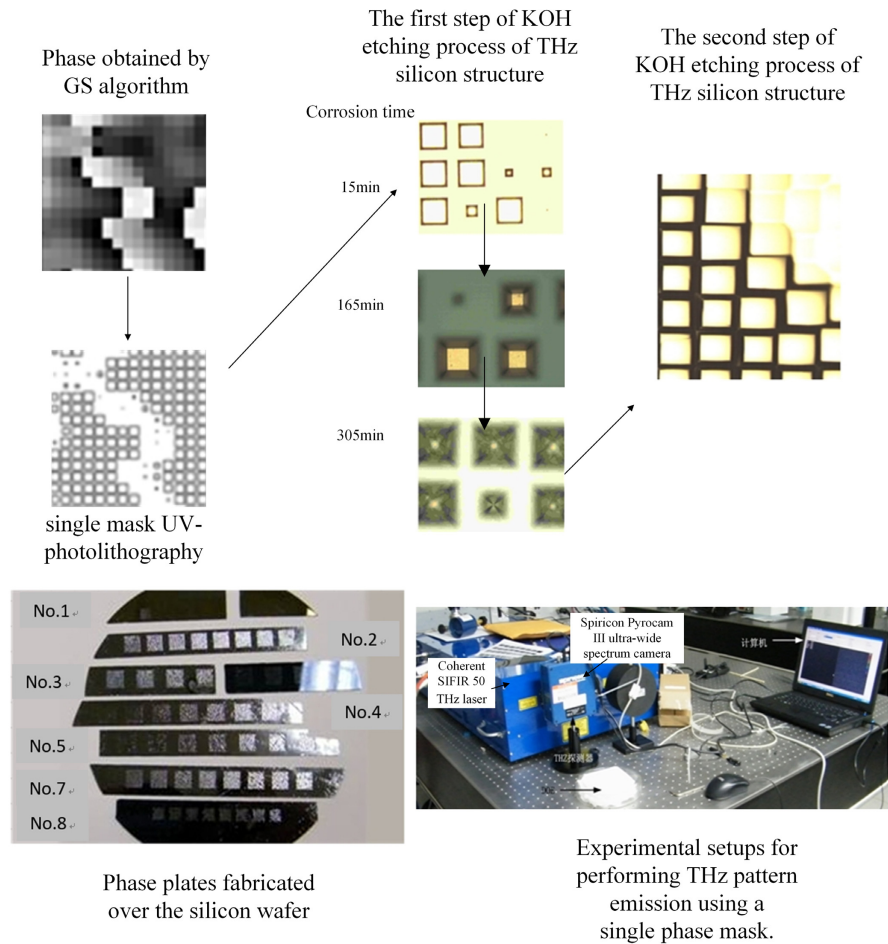


Fig. S1 The GS-based phase plates are fabricated over a silicon wafer by a single mask UV-photolithography and a dual-step KOH etching.

Through the first step of KOH wet etching, the silicon inverted pyramid structure is obtained. After the second step of KOH wet etching, the silicon inverted pyramid structure is evolved into a cambered surface that can be approximated by the spherical surface [S1, S2]. Since the lithography layout in the THz frequency usually has a relatively large opening size, it is essential to control the KOH etching time. In the actual implementation of the KOH etching for silicon structure, sometimes the method of observing and judging the formed topography by interrupting the etching process of the silicon wafer in etching process is used, so as to control the KOH wet etching process. The phase distribution of $0\sim 2\pi$ is discrete into 256 points.

The first KOH wet etching time of the THz silicon structure is about 305 minutes. The typical etching results are shown in Fig. S1. A flat crisscross can be observed under the microscope, marking that the inverted pyramid based on silicon wafer has been constructed. After the first KOH etching, the silicon dioxide mask on the silicon surface is removed with HF solution, and then the second KOH etching is started. The KOH etching reaction in the second step is much more violent than the first step. After the reaction, a step-shaped diffraction phase structure can be obtained. The sampling distance determines the wet etching time. Using the optimized KOH etching time, an ideal surface shape and height distribution of the surface phase step-like morphology can be obtained.

References

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