Supporting information

Hybrid metal-dielectric gratings (HMDG) as an alternative UV-SERS substrate

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This document provides supplementary information to "Hybrid metal-dielectric gratings (HMDG)-enhanced ultraviolet Raman spectroscopy". It includes more information about "The fabrication of quasi-bragg Si gratings and quasi-bragg Al gratings in the Section 1 and 2", "The definition of polarization in the Section 3", and "The polarization-dependence characteristic of the HMDG nanostructures in the Section 4".

1. The fabrication of quasi-bragg Si gratings

Si grating with 100-nm depth can be obtained via etching PR gratings which were acted as the mold. The periods of quasi-bragg grating can be tuned by controlling the incidence angles between two coherent light beams and exposure times. SEM images of quasi-bragg Si gratings with different periods are exhibited in the Figure S1a and the statistical histograms of slits are plotted in the Figure S1b. The experimental results demonstrate that the slits represent 40 nm, 90 nm, 100 nm and 115 nm corresponding to the periods of 300 nm, 400 nm, 500 nm and 600 nm, respectively.

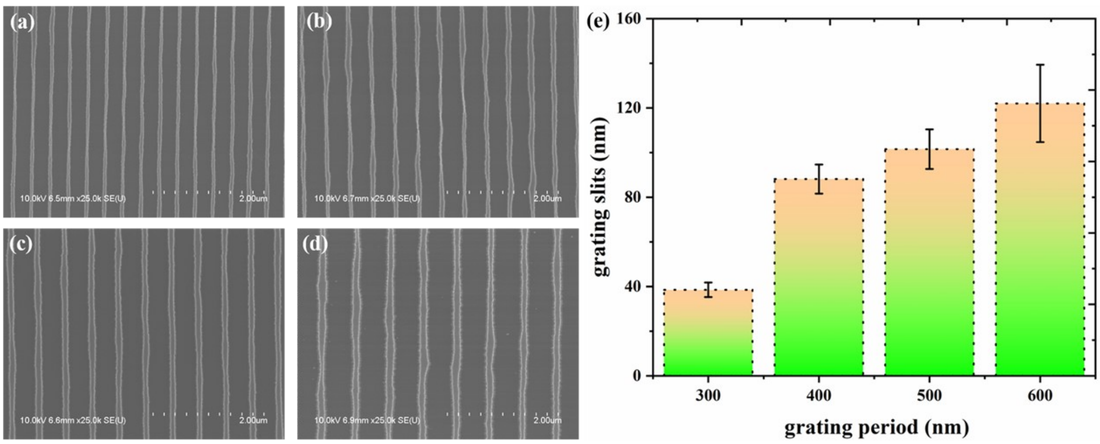

Fig. S1. SEM images of Si gratings with (a) 300, (b) 400, (c) 500 and (d) 600 nm period, respectively. (e) Statistical histograms of slits corresponding to Si gratings.

2. The fabrication of quasi-bragg Al gratings

To construct HMDG nanostructures, the Al film with 80-nm thickness was deposited onto the quasi-Bragg Si gratings utilizing electron beam depositing system. In this study, the periods of HMDG nanostructures are set as a range of 300, 400, 500 and 600 nm. The diversity of the slits is inevitable due to the exposure threshold value corresponding to the periodic parameters. SEM images of HMDG nanostructures with different periods are exhibited in the Figure S2a and the statistical histograms of slits are plotted in the Figure S2b. The experimental results demonstrate that the slits represent 90 nm, 120 nm, 150 nm and 190 nm corresponding to the periods of 300 nm, 400 nm, 500 nm and 600 nm, respectively.

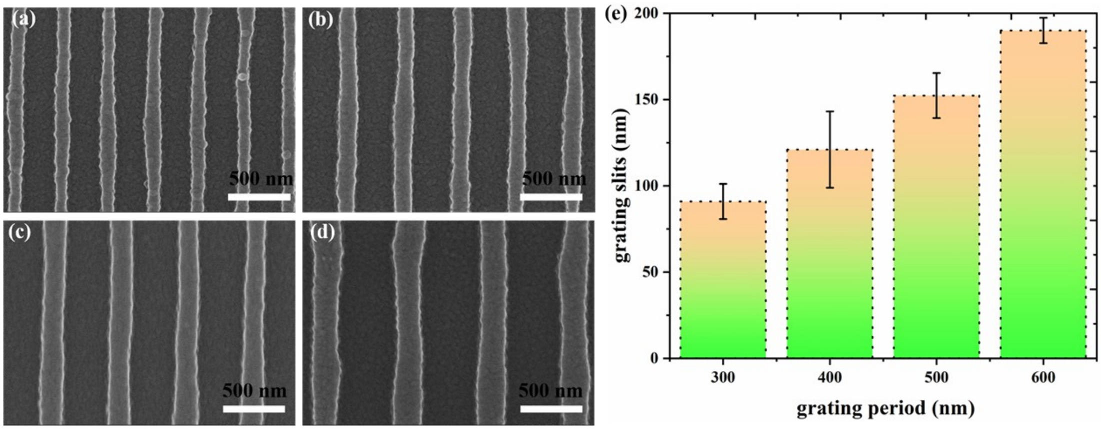

Fig. S2. SEM images of HMDG nanostructures with (a) 300, (b) 400, (c) 500 and (d) 600 nm period, respectively. (e) Statistical histograms of slits corresponding to HMDG nanostructures.

3. The definition of polarization

To better investigate the UV-SERS performance of HMDG nanostructure, the optical properties of HMDG-400 nanostructure are investigated by utilizing a polarized light by tuning the azimuthal angles. The definition of polarization can be found in the Figure S3.

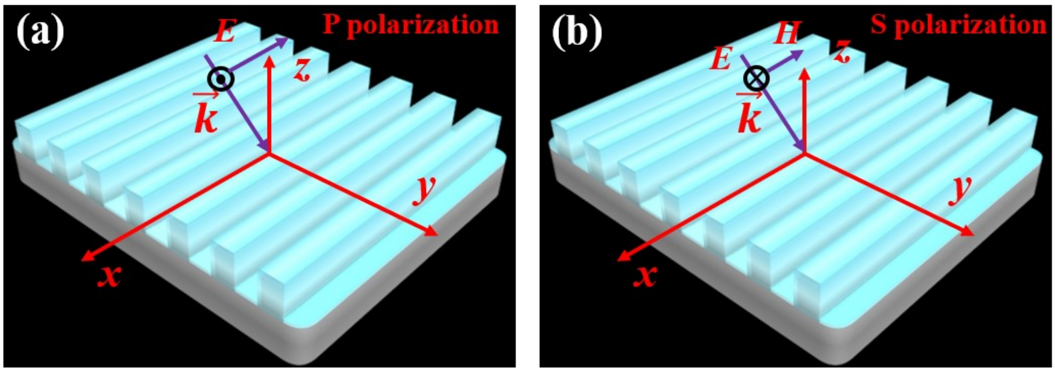

Fig. S3. The definition of polarization. (a) P polarization and (b) S polarization.

4. The polarization-dependence characteristic of the HMDG nanostructures

The polarization-dependence characteristic has been performed in the Figure S4. We can obviously observe that the unpolarized spectrum is the sum of the two spectra obtained at P and S polarization in Figure S4b and Figure S4c. The definition of polarization can be found in the Figure S3. Experimental results demonstrate that P polarization plays a dominate role in the HMDG nanostructures. The wavelength of SPP modes governed by 75° illumination angle shift blue from the NIR to the near ultraviolet regions, however, the hybrid modes slightly shift blue as the increasing of the azimuthal angles.

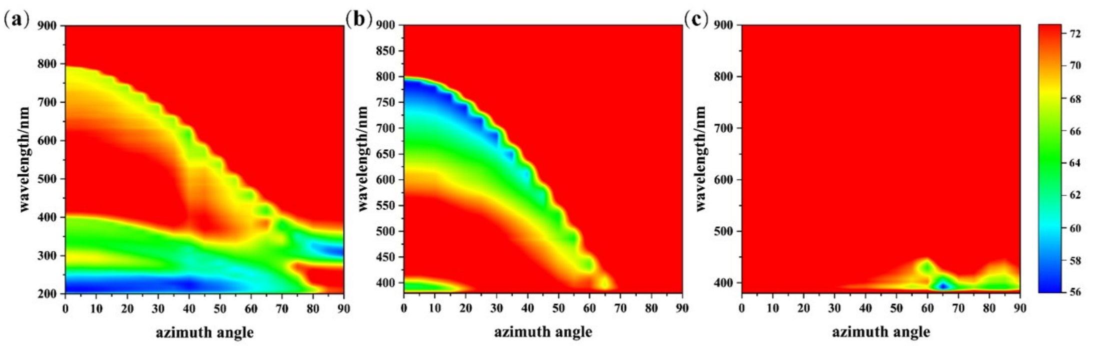

Fig. S4. Polarization dependent reflectance spectra obtained on HMDG-400 with 75° illumination angle at varied azimuthal angles for (a) unpolarization, (b) P polarization, and (c) S polarization.