Plasmonic metagratings for simultaneous determination of Stokes parameters: supplementary materials

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This document provides supplementary information to "Plasmonic metagratings for simultaneous determination of Stokes parameters," <http://dx.doi.org/10.1364/optica.2.000716>. We provide numerical calculations of metasurface diffraction efficiencies and contrasts as a function of wavelength, measurements of diffraction contrasts of the metagrating at wavelengths 750 nm and 850 nm, and tabulated values of the measured diffraction contrasts at the wavelength of 800 nm. © 2015 Optical Society of America

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Fig. S1. Theoretical performance of phase-gradient metasurfaces. The figures display the amount of incident light reflected into the diffraction orders $|m| \leq 2$ as a function of wavelength for the three metasurfaces and the two associated orthogonal polarization states. For metasurface 1 (MS1), the performance is shown for the polarization unit vector (a) $\hat{x}$ and (b) $\hat{y}$; for metasurface 2 (MS2), the polarization vector is (c) $\hat{a}$ and (d) $\hat{b}$; for metasurface 3 (MS3), the polarization vector is (e) $\hat{r}$ and (f) $\hat{l}$.

Fig. S2. Theoretical surface plots of diffraction contrasts. The figures display the three-dimensional surface spanned by the diffraction contrasts D_i as all polarization states are covered. Calculations have been performed in the wavelength range 600-1100 nm with steps of 50 nm. The meshed surfaces represent the Poincaré sphere, while three error estimates are reported in each figure: $err_1 = \max\{s_i/s_0 - D_i\}$ corresponds to the maximum deviation in any of the three diffraction contrasts; $err_2 = \max\{\|\mathbf{S} - \mathbf{D}\|_2\}$ is the maximum (2-norm) error in any set of diffraction contrasts, with $\mathbf{S} = (s_1, s_2, s_3)/s_0$ being the normalized Stokes parameters and $\mathbf{D} = (D_1, D_2, D_3)$; $err_3 = \langle \|\mathbf{S} - \mathbf{D}\|_2 \rangle$ where $\langle \dots \rangle$ denotes averaging over all polarization states.

Fig. S3. Metagrating functionality away from design wavelength. The figures display the measured diffraction contrasts (denoted by filled circles) for polarization states along the main axes of the Poincaré sphere (indicated by asterisk symbols) for light wavelengths of 750 nm and 850 nm. The average (2-norm) deviation between the Stokes vector of the incident light and the measured diffraction contrasts is ~ 0.2 and ~ 0.1 at the wavelength 750 nm and 850 nm, respectively.

Stokes param.	Meas. 1	Meas. 2	Meas. 3	Average	Error
(0.5, 0.866, 0)	(0.518, 0.880, 0.008)	(0.536, 0.901, -0.073)	(0.539, 0.897, -0.054)	(0.531, 0.893, -0.040)	0.057
(-0.5, 0.866, 0)	(-0.502, 0.883, 0.111)	(-0.529, 0.915, 0.125)	(-0.485, 0.891, 0.111)	(-0.505, 0.896, 0.116)	0.120
(0.5, 0, 0.866)	(0.578, 0.050, 0.831)	(0.536, 0.055, 0.765)	(0.549, 0.067, 0.780)	(0.554, 0.057, 0.792)	0.108
(-0.5, 0, 0.866)	(-0.499, 0.055, 0.944)	(-0.489, 0.091, 0.922)	(-0.484, 0.060, 0.951)	(-0.490, 0.069, 0.939)	0.101
(1, 0, 0)	(0.995, 0.105, -0.083)	(0.995, 0.077, -0.082)	(0.991, 0.112, -0.079)	(0.994, 0.098, -0.081)	0.128
(0.5, 0, -0.866)	(0.547, 0.188, -0.968)	(0.527, 0.129, -0.930)	(0.510, 0.193, -0.930)	(0.528, 0.170, -0.943)	0.188
(-0.5, 0, -0.866)	(-0.514, 0.185, -0.824)	(-0.476, 0.128, -0.791)	(-0.486, 0.199, -0.786)	(-0.492, 0.171, -0.800)	0.183
(-1, 0, 0)	(-0.995, 0.125, 0.122)	(-0.995, 0.178, 0.177)	(-0.995, 0.148, 0.223)	(-0.995, 0.125, 0.122)	0.175
(1, 0, 0)	(0.994, 0.155, -0.023)	(0.995, 0.109, -0.026)	(0.996, 0.182, -0.119)	(0.995, 0.148, -0.056)	0.159
(0.5, -0.866, 0)	(0.579, -0.810, -0.015)	(0.543, -0.814, -0.038)	(0.526, -0.817, -0.050)	(0.549, -0.814, -0.034)	0.080
(-0.5, -0.866, 0)	(-0.470, -0.767, 0.093)	(-0.486, -0.813, 0.059)	(-0.482, -0.796, 0.080)	(-0.480, -0.792, 0.078)	0.109
(-1, 0, 0)	(-0.993, 0.193, 0.152)	(-0.993, 0.148, 0.142)	(-0.994, 0.180, 0.081)	(-0.994, 0.101, 0.058)	0.117
(0, 1, 0)	(0.012, 0.996, -0.032)	(0.002, 0.991, 0.051)	(-0.009, 0.994, 0.045)	(0.002, 0.994, 0.021)	0.022
(0, 0, -1)	(-0.021, 0.204, -0.976)	(-0.065, 0.162, -0.977)	(-0.065, 0.165, -0.981)	(-0.034, 0.141, -0.981)	0.146
(0, 0, 1)	(0.031, 0.048, 0.981)	(-0.007, 0.062, 0.992)	(-0.012, 0.053, 0.993)	(0.004, 0.054, 0.989)	0.056
(0, -1, 0)	(0.043, -0.976, 0.039)	(0.022, -0.978, -0.002)	(0.031, -0.979, 0.042)	(0.032, -0.978, 0.026)	0.047

Table S1. Measured diffraction contrasts from metagrating for different states of polarization of incident light. Column 1 indicates the normalized Stokes parameters for the (ideal) state of polarization of the incident light, while column 2-5 contains the measured diffraction contrasts and the average values. Column 6 displays the 2-norm error $\|\mathbf{S} - \mathbf{D}\|_2$, where $\mathbf{S} = (s_1, s_2, s_3)/s_0$ is the normalized Stokes vector and $\mathbf{D} = (D_1, D_2, D_3)$ is the average values of the measured diffraction contrasts.