Polarization driven control over scattering of a silicon nanoparticle on one-layered substrate

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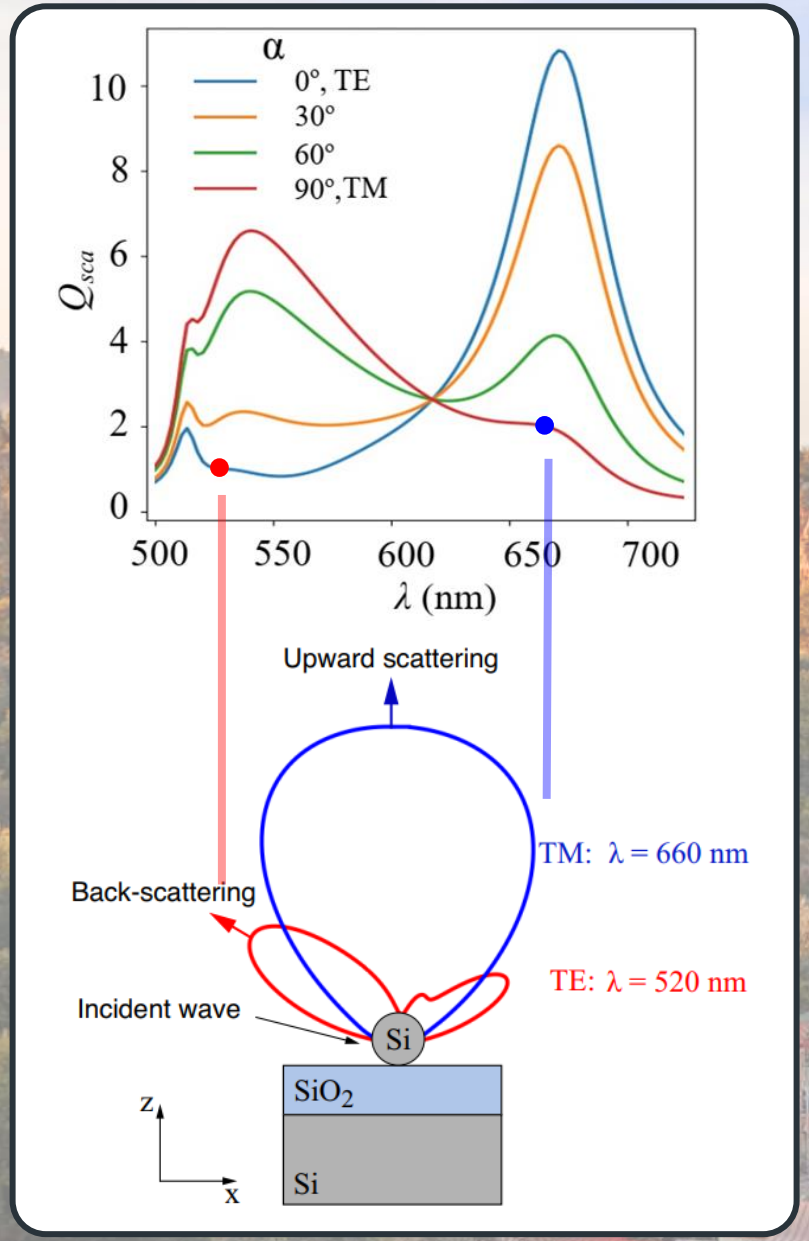
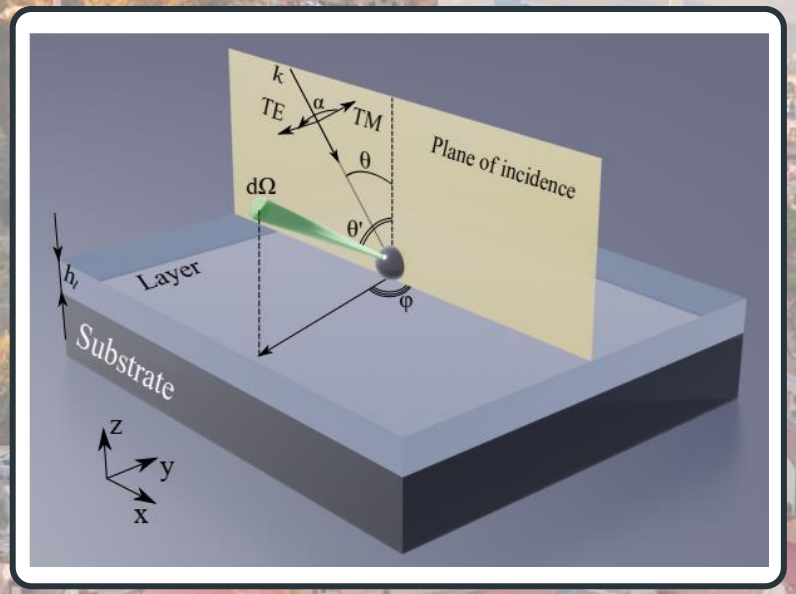
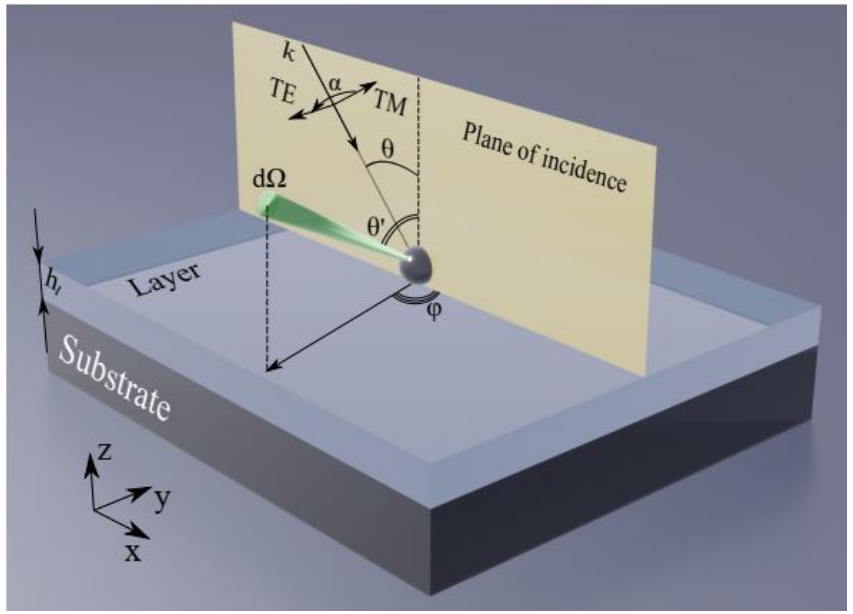
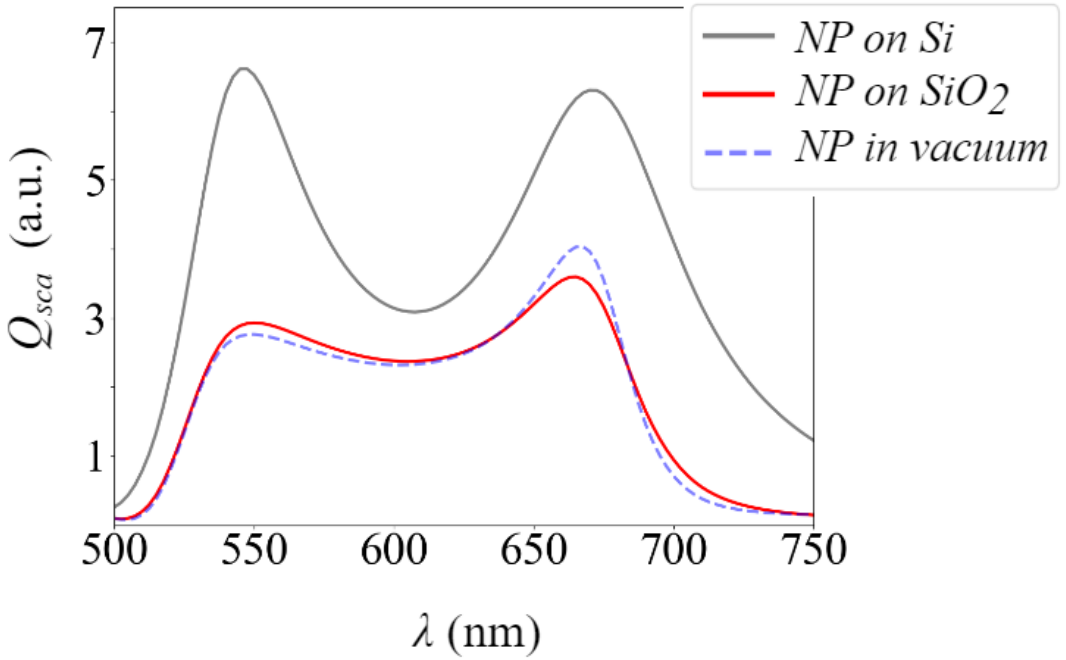
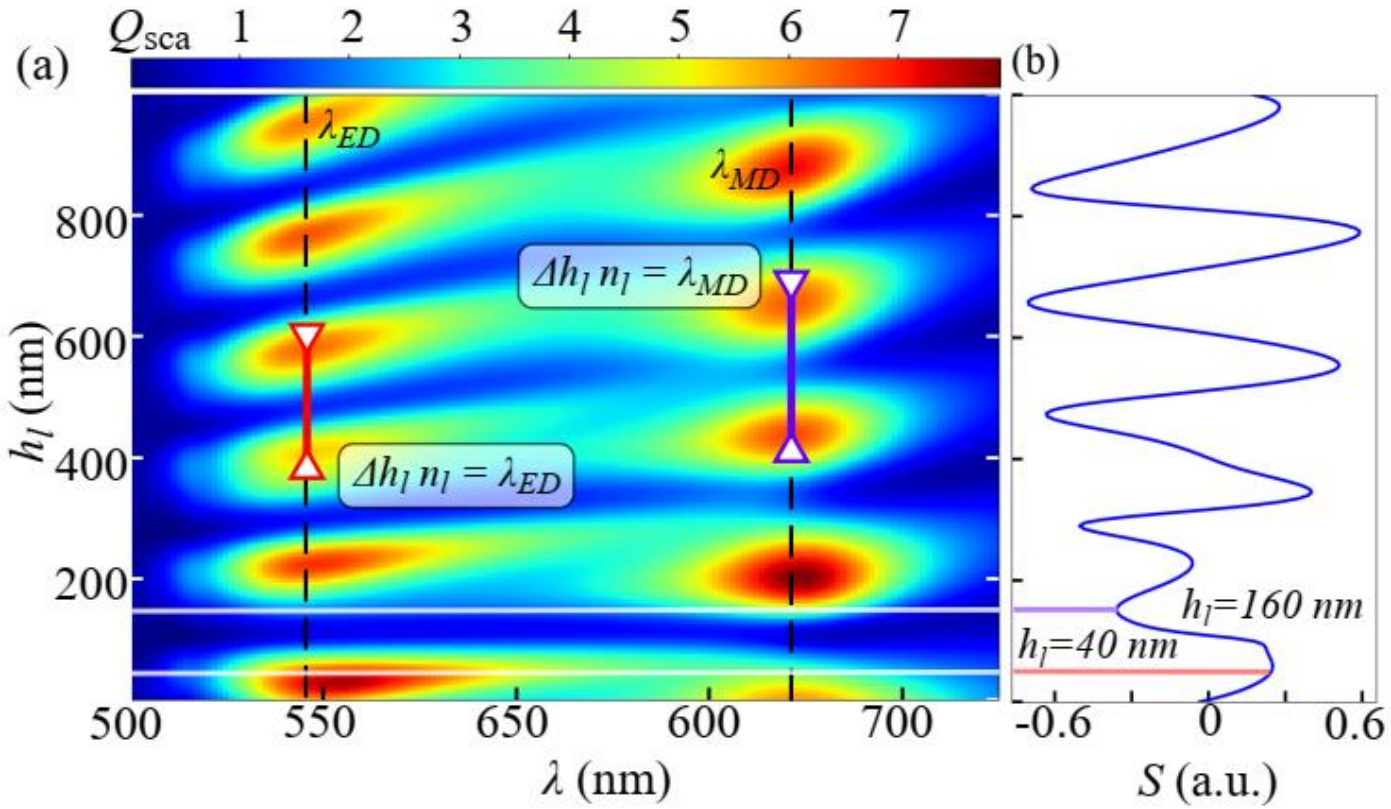


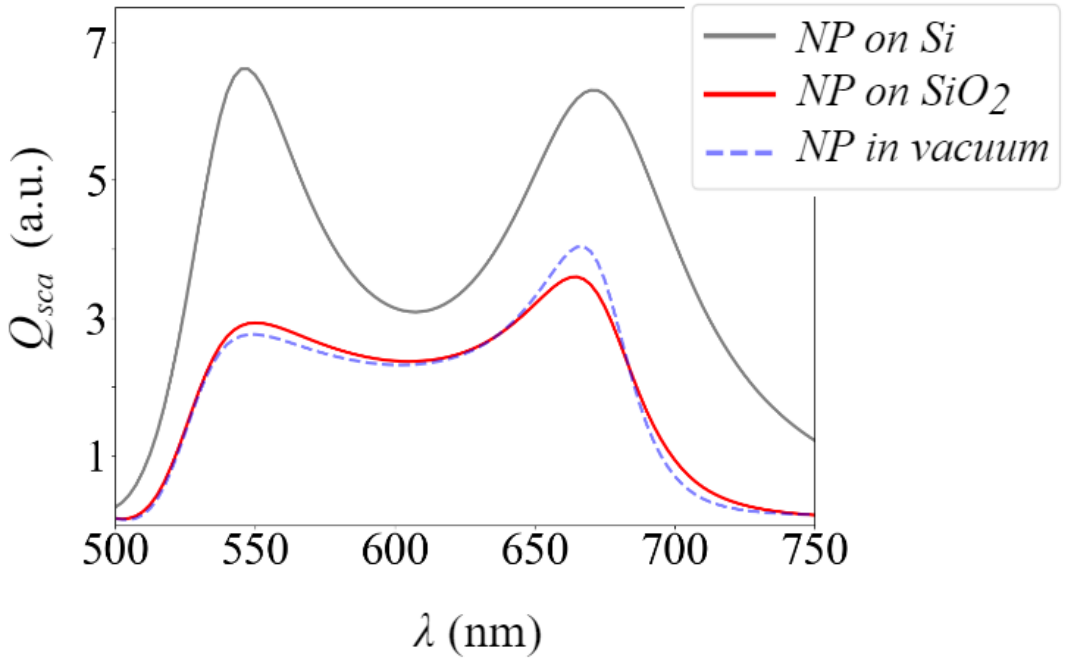


Preview


k
TE
α
TM
θ
dΩ
θ'
Plane of incidence
h
Layer
φ
Substrate
z
y
x

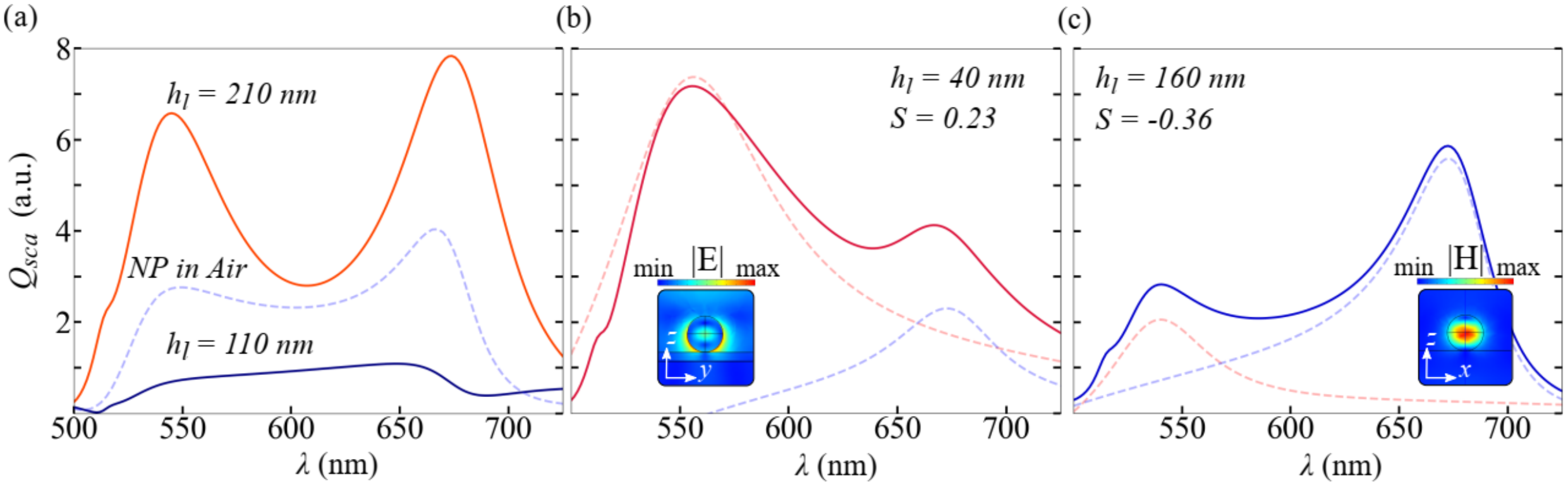

NP on Si
NP on SiO2
NP in vacuum
Qsca (a.u.)
7
5
3
1
500
550
600
650
700
750
λ (nm)



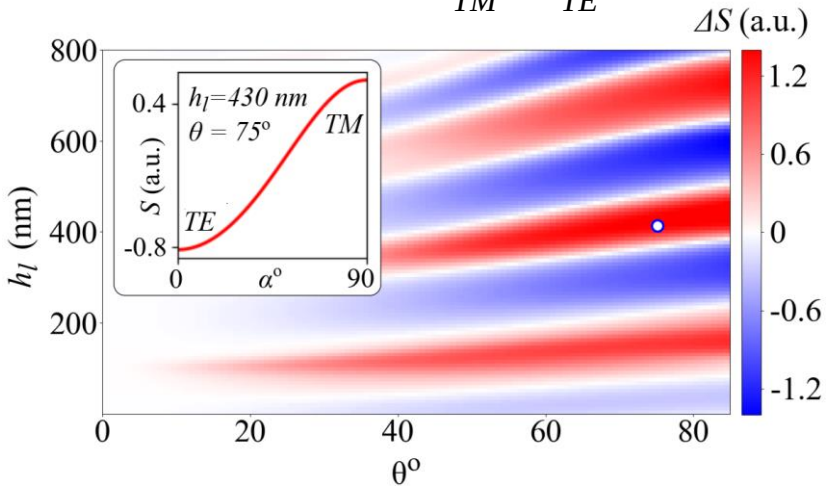


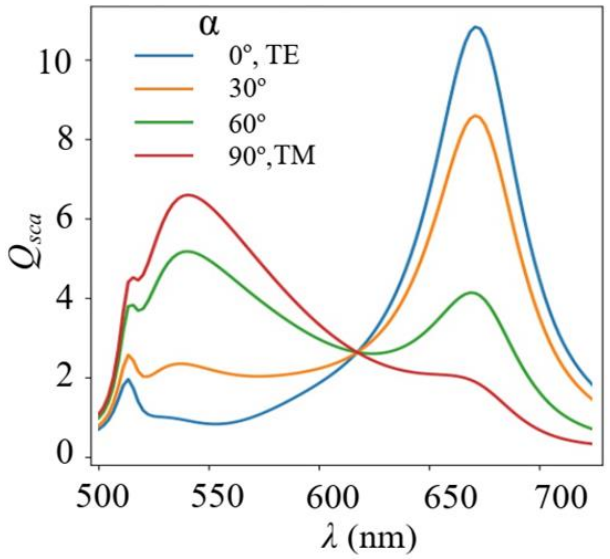
$$d_0 + h_l n_l = m\lambda$$

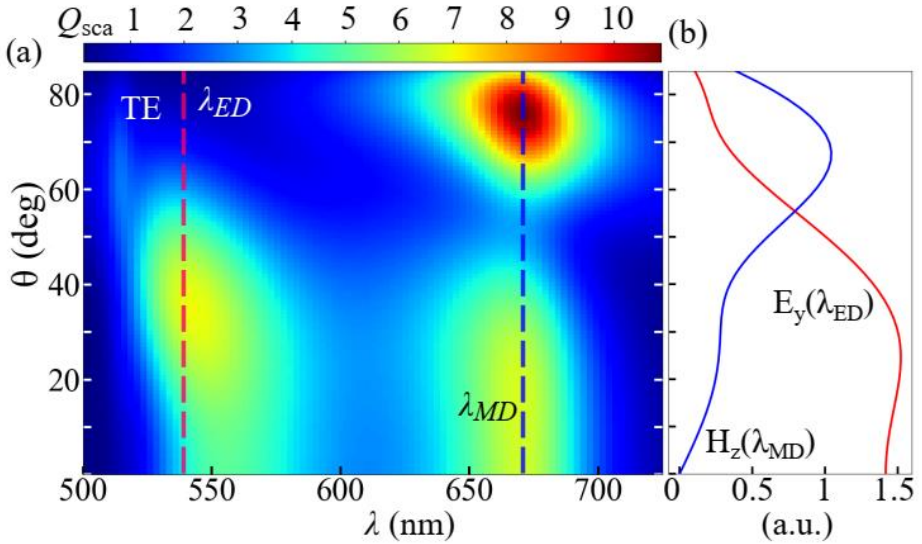
$$S = \frac{Q(\lambda_{ED}) - Q(\lambda_{MD})}{Q(\lambda_{ED}) + Q(\lambda_{MD})}$$

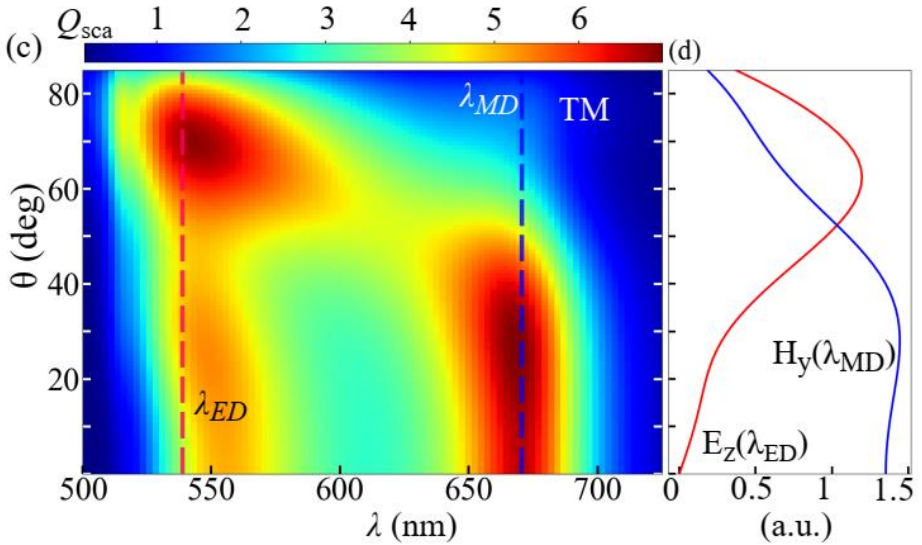

(a)
(b)
(c)
h_l = 210 nm
NP in Air
h_l = 110 nm
Q_{sca} (a.u.)
λ (nm)
h_l = 40 nm
S = 0.23
min |E| max
h_l = 160 nm
S = -0.36
min |H| max

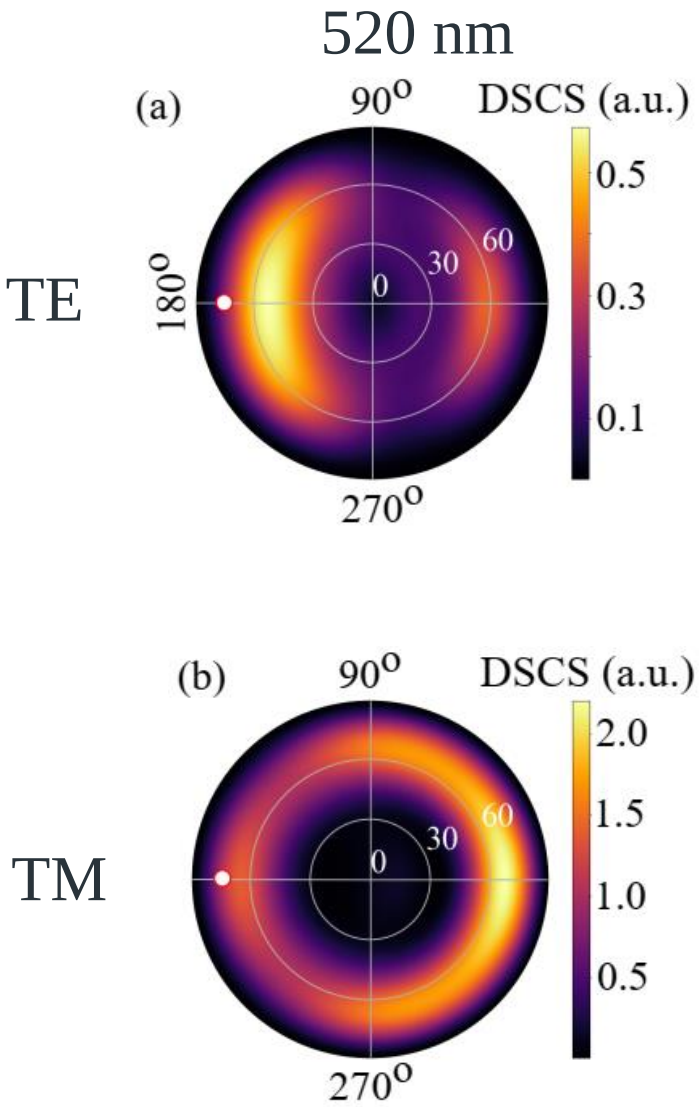
$\Delta S = S_{TM} - S_{TE}$

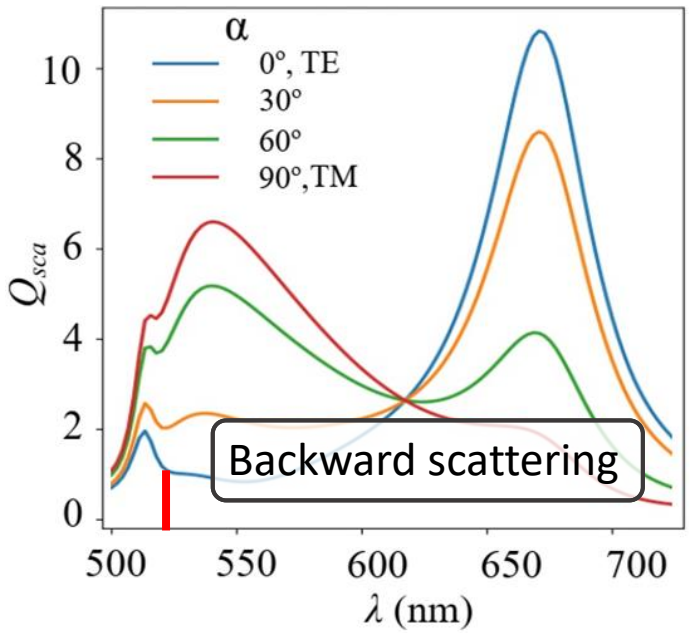









520 nm
TE
(a)
90°
DSCS (a.u.)
0.5
0.3
0.1
180°
0
30
60
270°
TM
(b)
90°
DSCS (a.u.)
2.0
1.5
1.0
0.5
0
30
60
270°

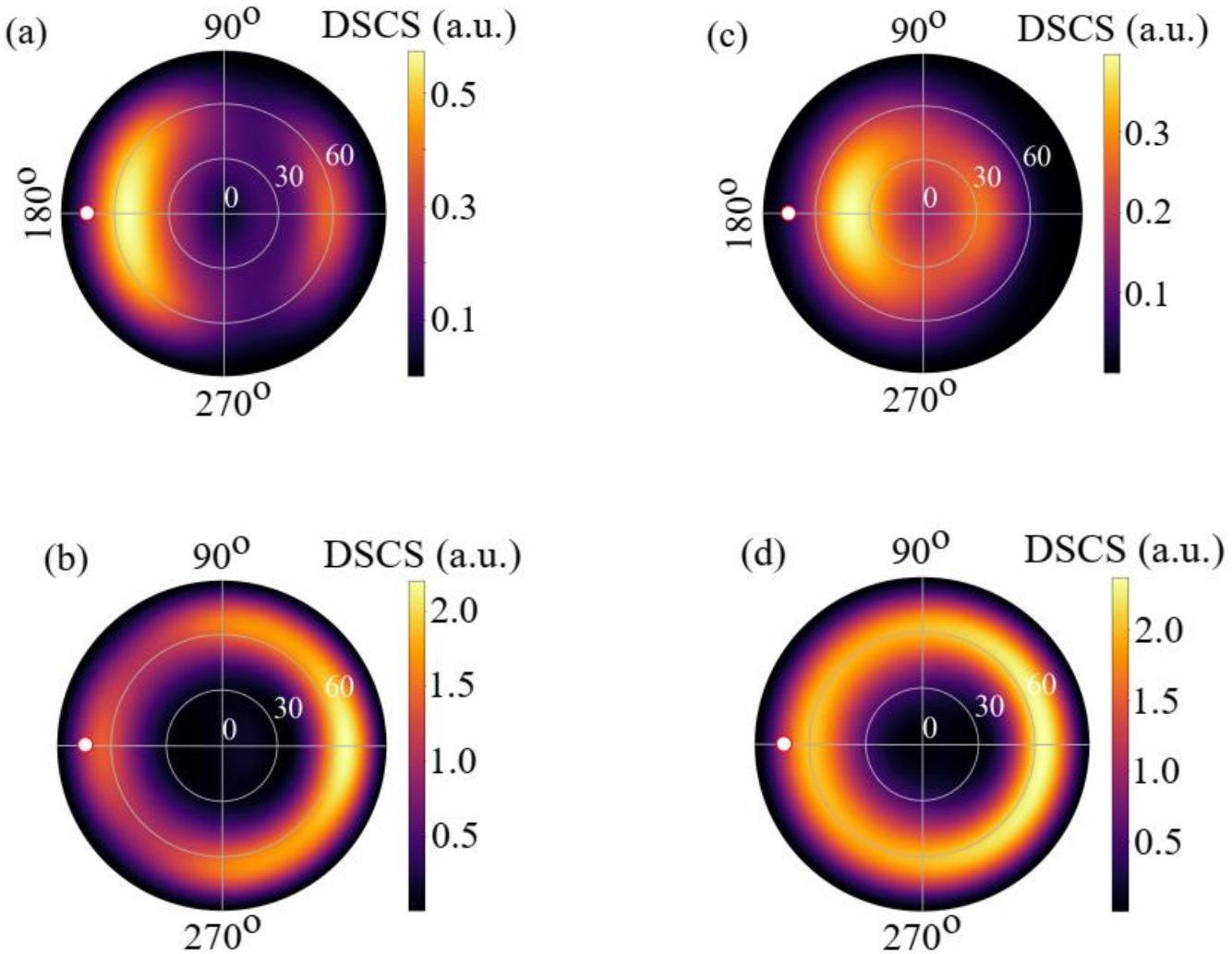

α
0°, TE
30°
60°
90°,TM
Q_{sca}
10
8
6
4
2
0
500
550
600
650
700
λ (nm)
Backward scattering

520 nm

540 nm

TE

TM



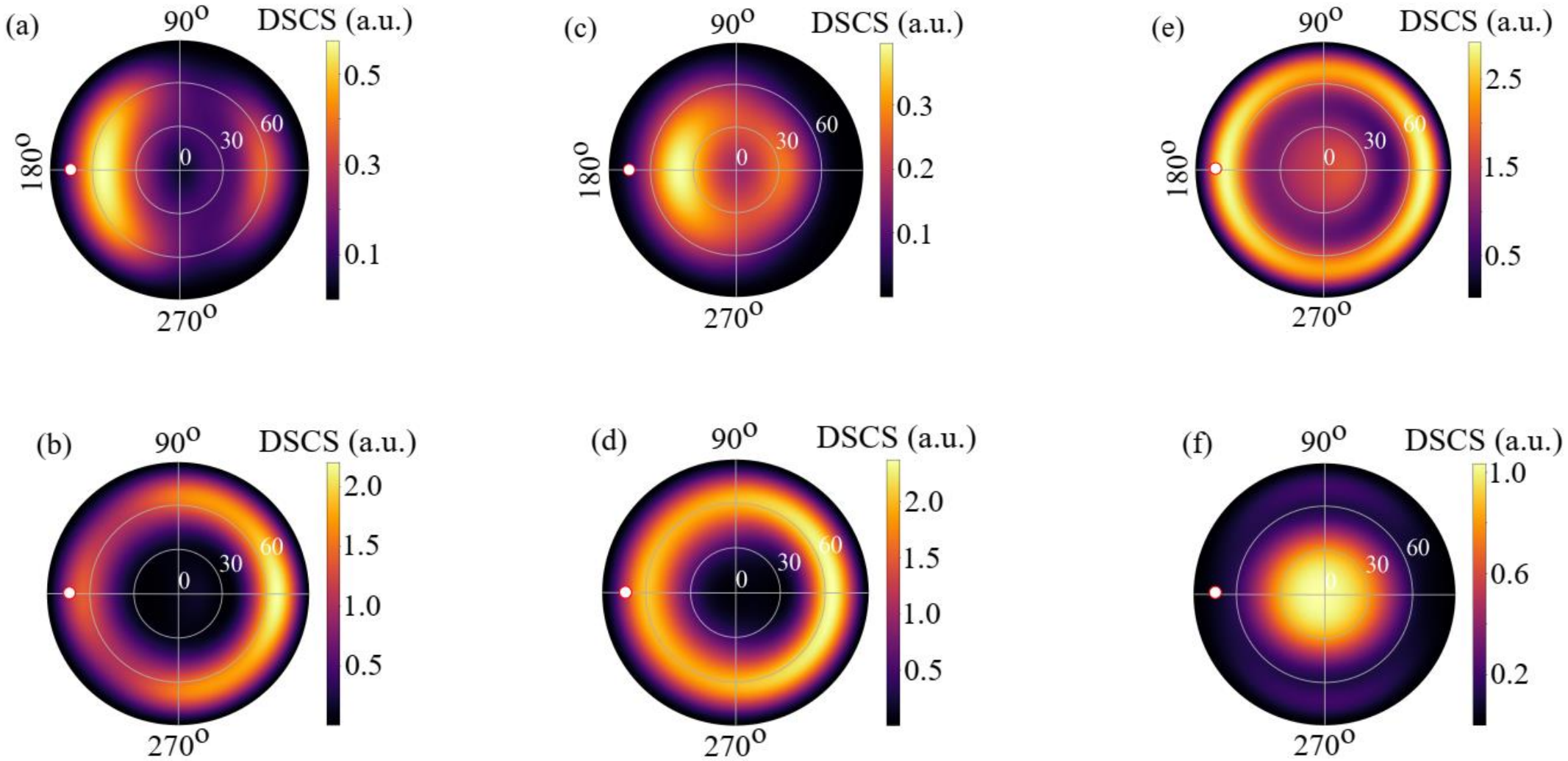
520 nm

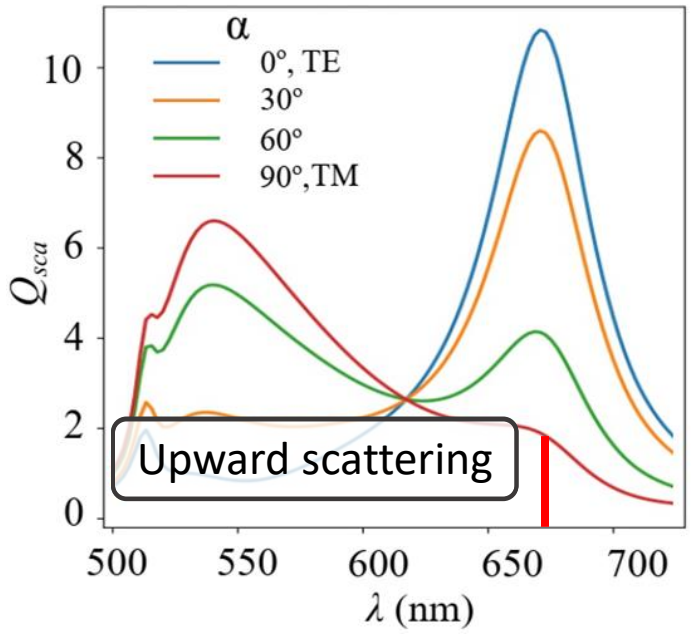
540 nm

660 nm

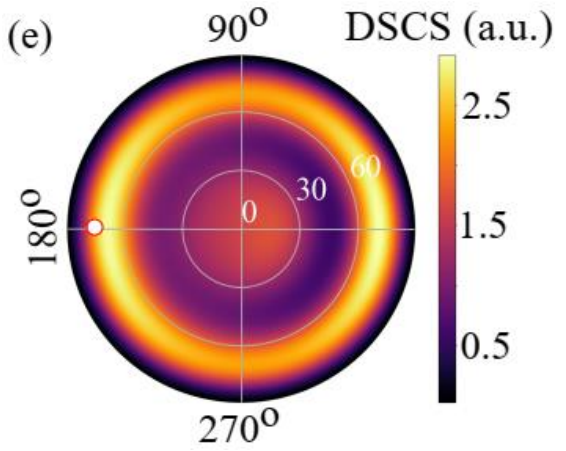
TE

TM

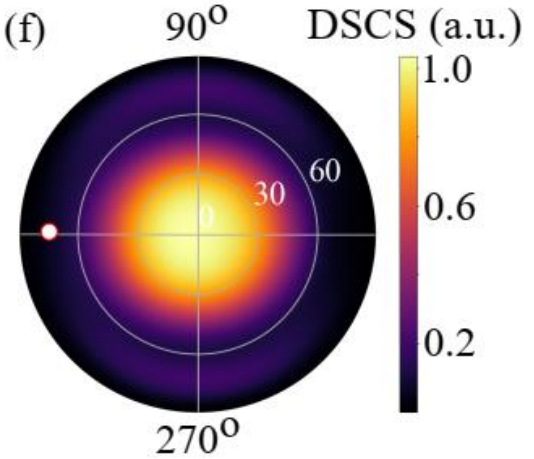


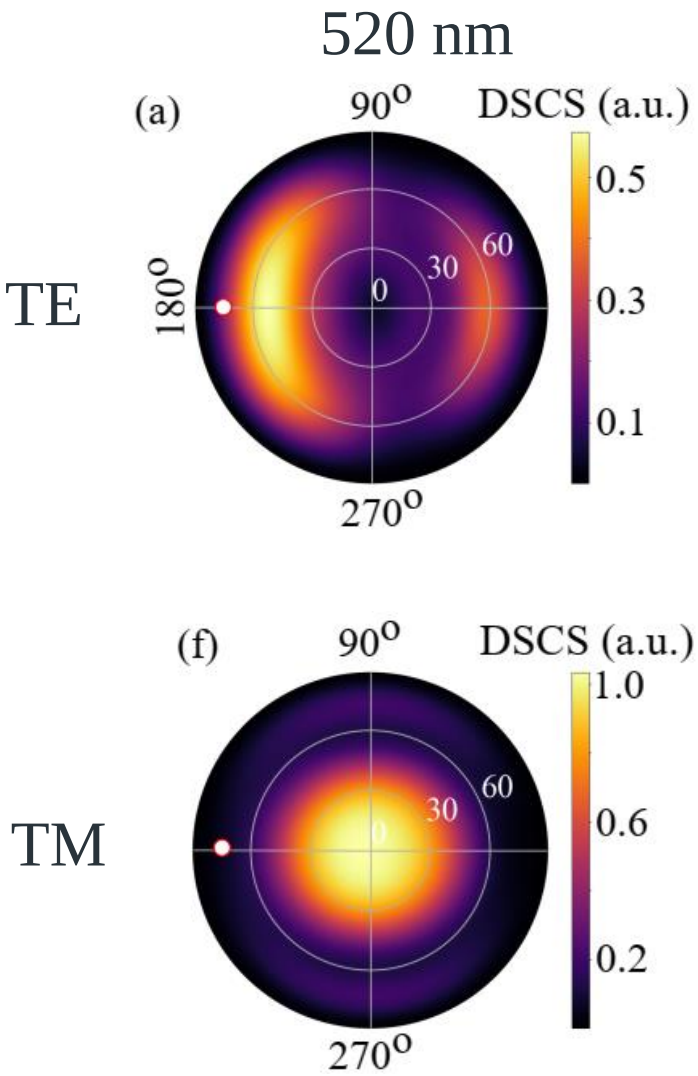

α
0°, TE
30°
60°
90°,TM
Q_{sca}
λ (nm)
Upward scattering

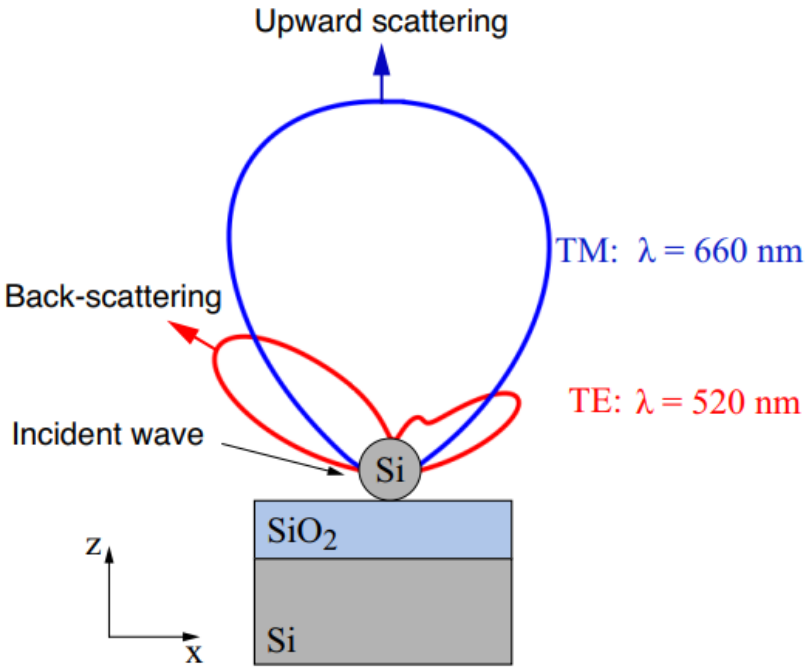
TE 660 nm


(e)
90°
DSCS (a.u.)
180°
270°
0
30
60
2.5
1.5
0.5

TM


(f)
90°
DSCS (a.u.)
270°
0
30
60
1.0
0.6
0.2


520 nm
(a)
90°
DSCS (a.u.)
0.5
0.3
0.1
TE
180°
0
30
60
270°
(f)
90°
DSCS (a.u.)
1.0
0.6
0.2
TM
180°
0
30
60
270°


Upward scattering
TM: λ = 660 nm
Back-scattering
TE: λ = 520 nm
Incident wave
Si
SiO2
Si
z
x

- At normal incidence, the thickness of the layer controls the enhancement and suppression of the ED and the MD
- At oblique incidence, it becomes possible to control the contribution of the ED and the MD to the optical response through polarization of the incident light
- We found negative angle and upward scattering regimes, and show that adjusting the ED and the MD contributions controls directivity of scattered radiation.

ACKNOWLEDGEMENT

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