Controlling Angular Dispersions in Metasurfaces: Physics and Applications

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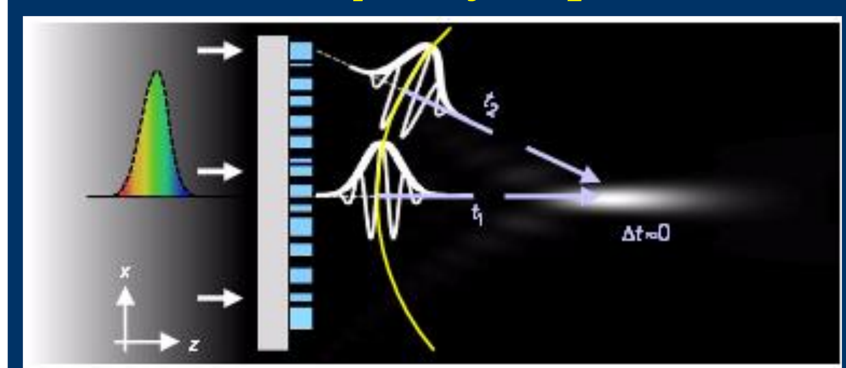
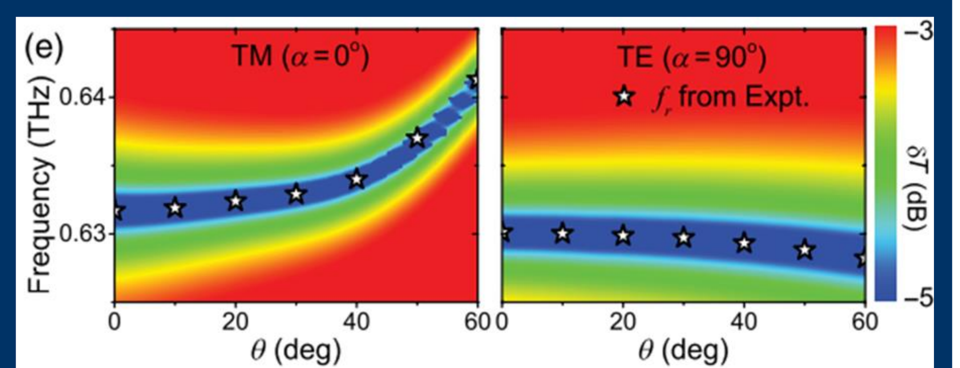
◆ Backgrounds

Frequency dispersion [1]



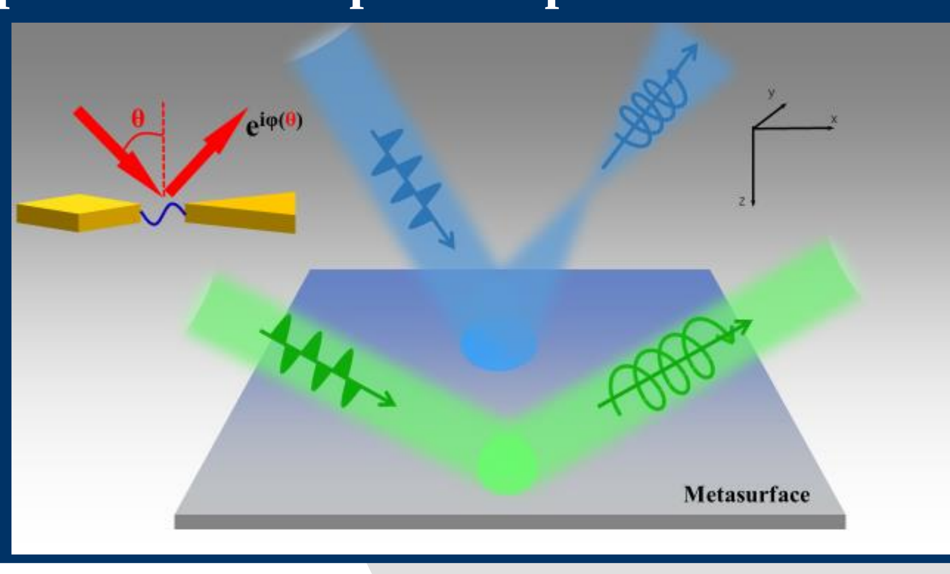
Angular Dispersions [2]



- Intrinsic physics of angular dispersions in metasurfaces remains unclear;
- Angular dispersions were rarely employed in the design of metasurface.

◆ Motivations

- Understand physical origin of angular dispersion in Metasurfaces
- Use angular dispersions as a new degree of freedom to design meta-devices with angular dependent or independent performances



I Angular dispersions in Metasurfaces

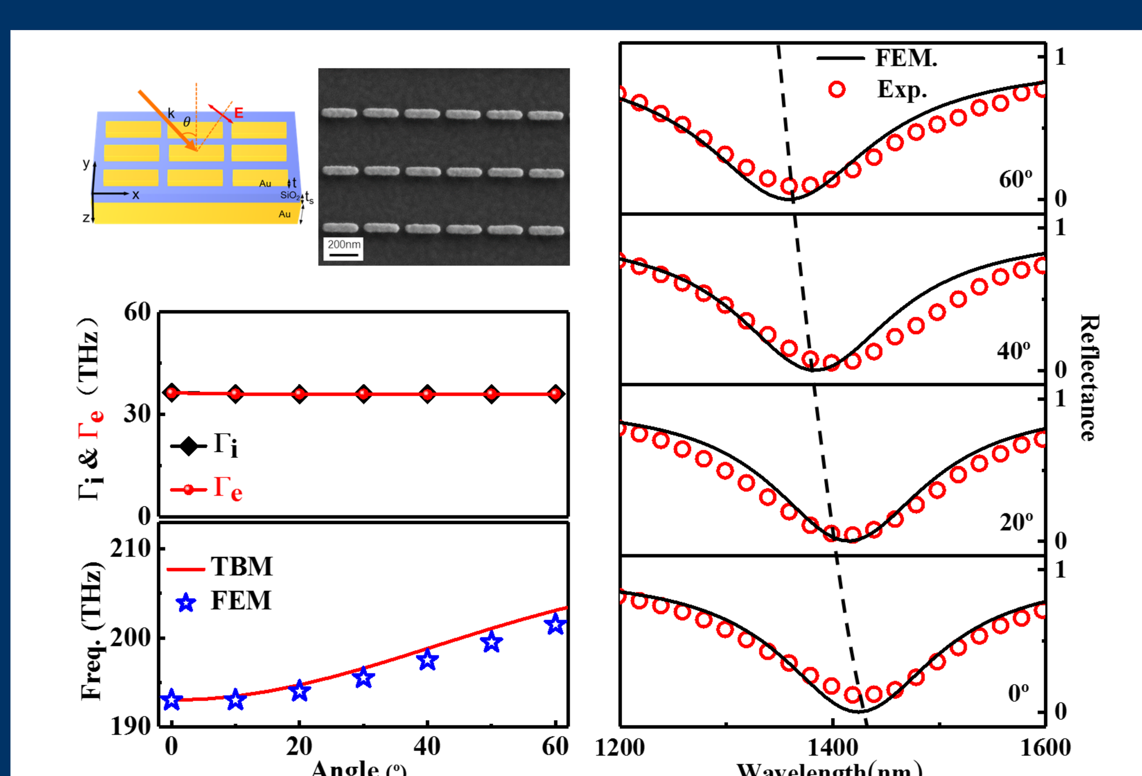


Fig1. Strongly angular dispersive perfect absorber

Resonance frequency:
$f(\theta) = f_0 + J_0 + J_1\cos(Pk_0 sin\theta) + J_2\cos(2Pk_0 sin\theta) + ...$ [2]

II Control resonant frequency with angular dispersions

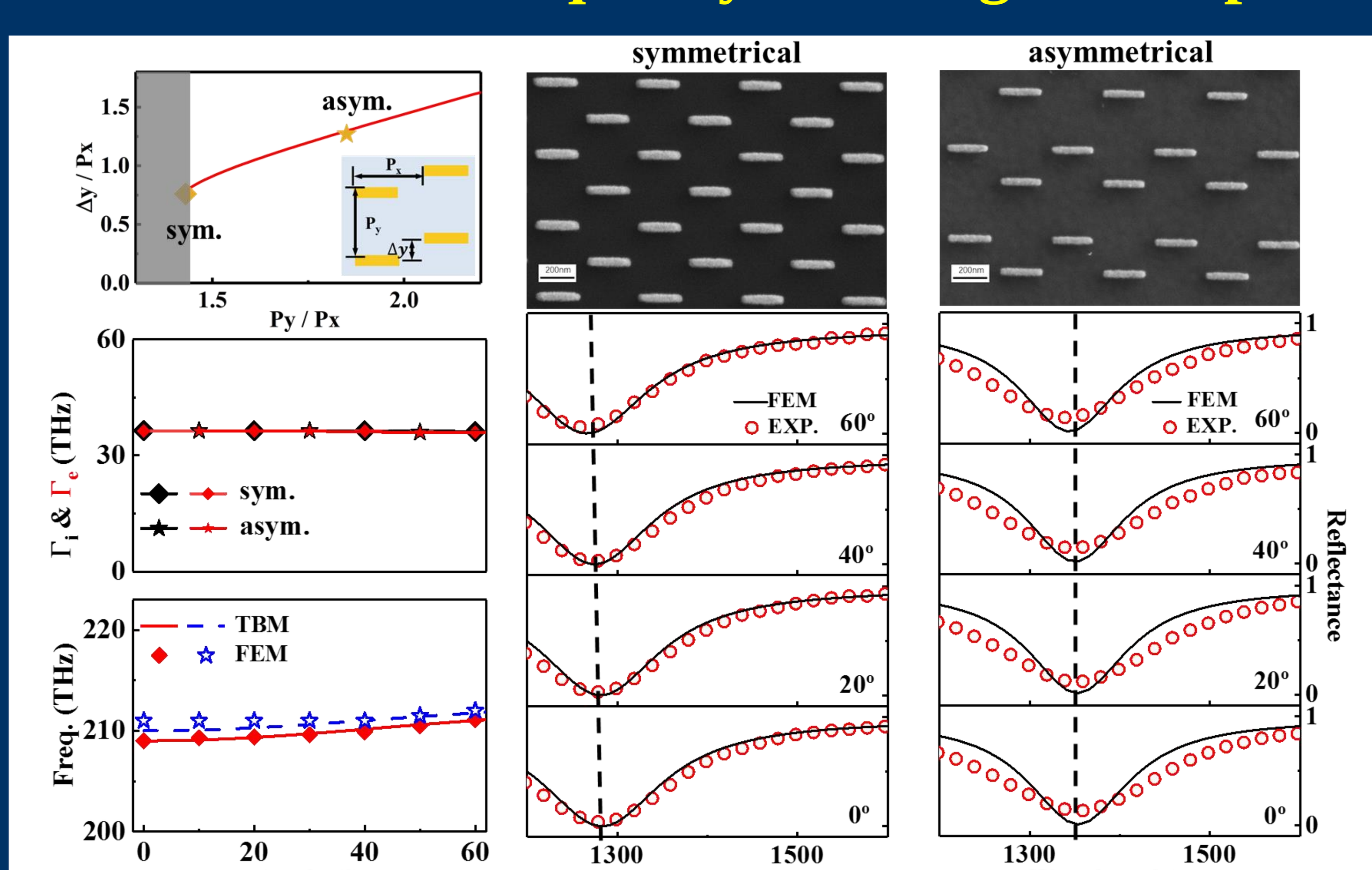


Fig2. Incident-Angle-independent perfect absorber

Nearest- neighbor intrarow couplings: $J_1 = 2\sum_{i=-n}^{n} t_{\{0,0\}}^{\{i,1\}}$

Inter-atom coupling: $t_{\{m,n\}}^{\{k,l\}} = -f_0 \frac{\int \vec{P}^*_{\{m,n\}}(\vec{r})\cdot \vec{E}_{\{k,l\}}(\vec{r})\, d\tau}{\langle \emptyset_s|\emptyset_s\rangle}$

III Control Q factor with angular dispersions

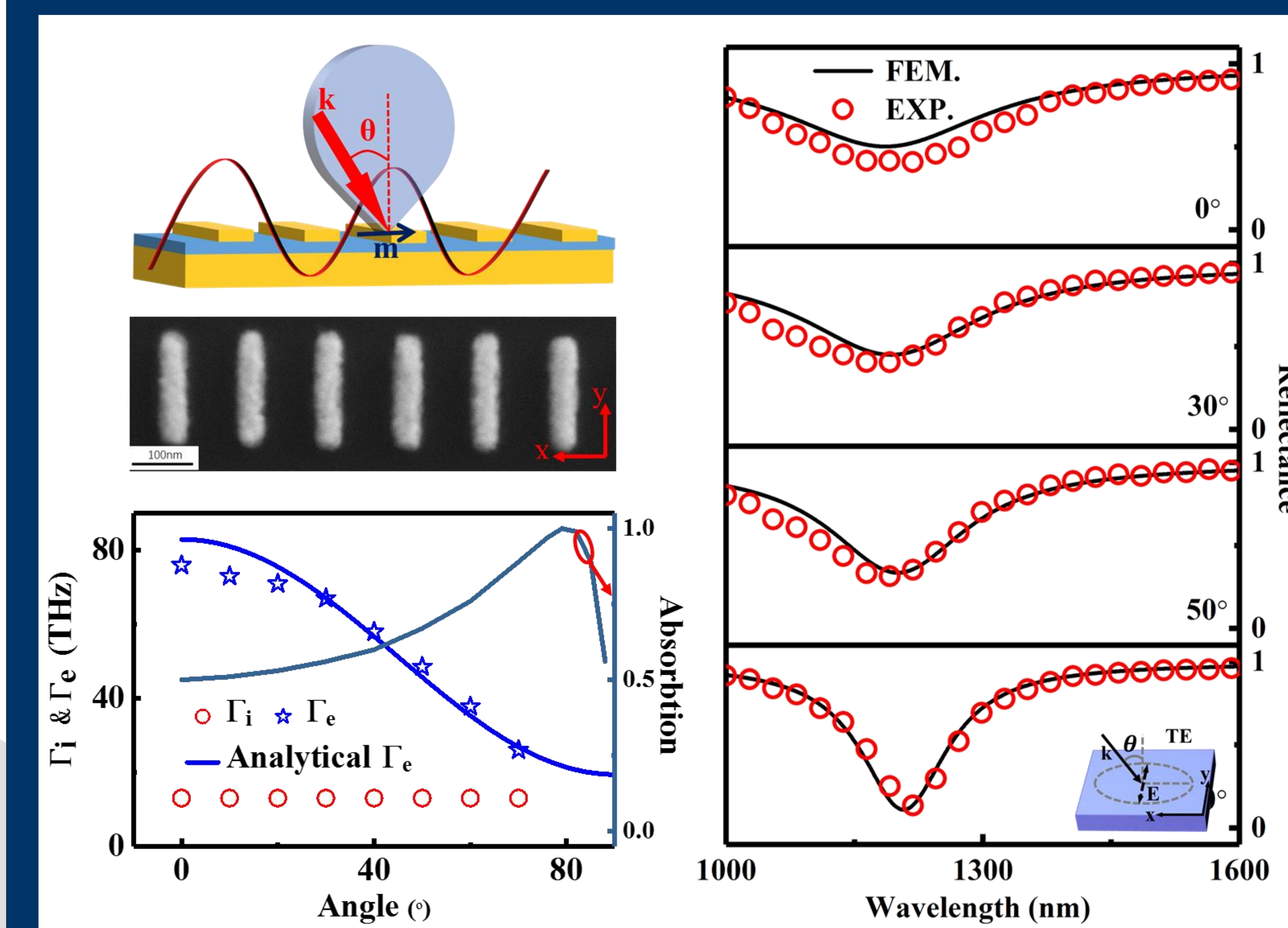


Fig3. Angle selective perfect absorber

Perfect absorption: $\Gamma_i = \Gamma_e$ [3]

IV Applications: Angle-dependent Polarizer

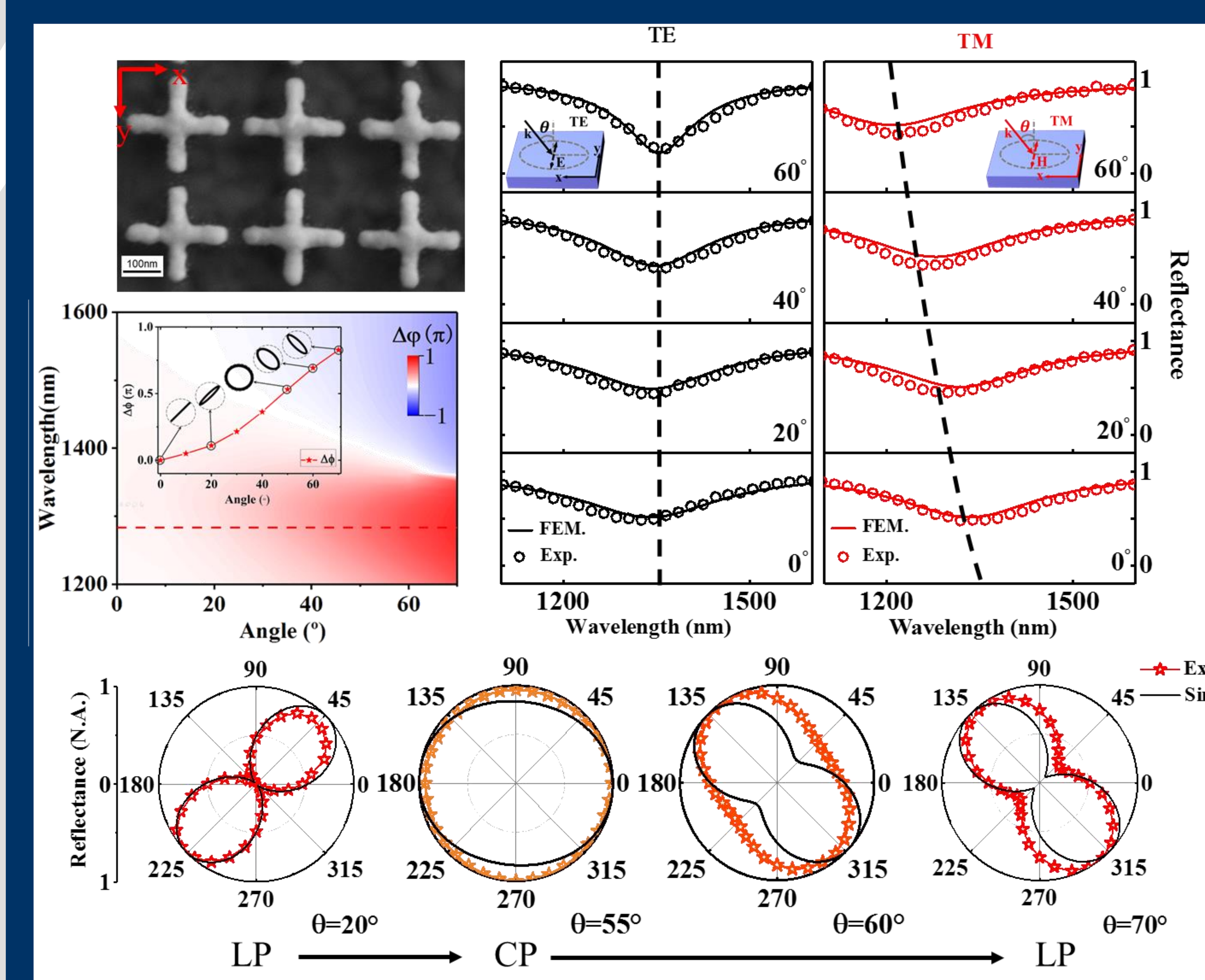


Fig4. Incident-Angle dependent polarization control in NIR regime

Conclusions:

1. Control resonant frequency and line shape with Angular dispersions
2. Experimental demonstration of NIR Angle-dependent Polarizer
3. Employ angular dispersions as a new degree of freedom to design incident-angle-dependent multifunctional meta-devices

References:

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