Perfect Absorption and Broadband Non-reflection with Transmissive Metasurface

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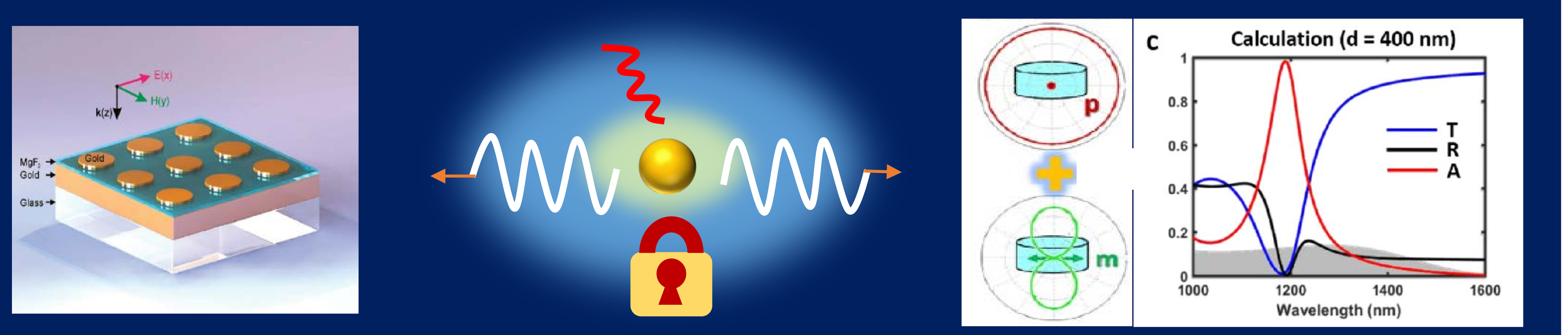
◆ Backgrounds

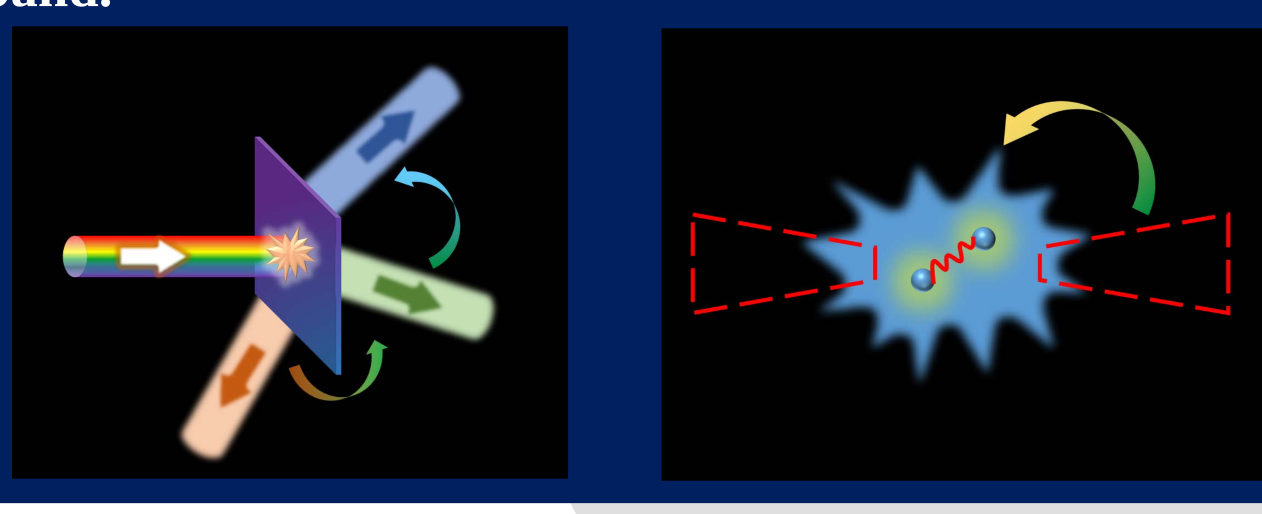
No Transmission channel — *Locked functions* — *Hard to get equal responnses*



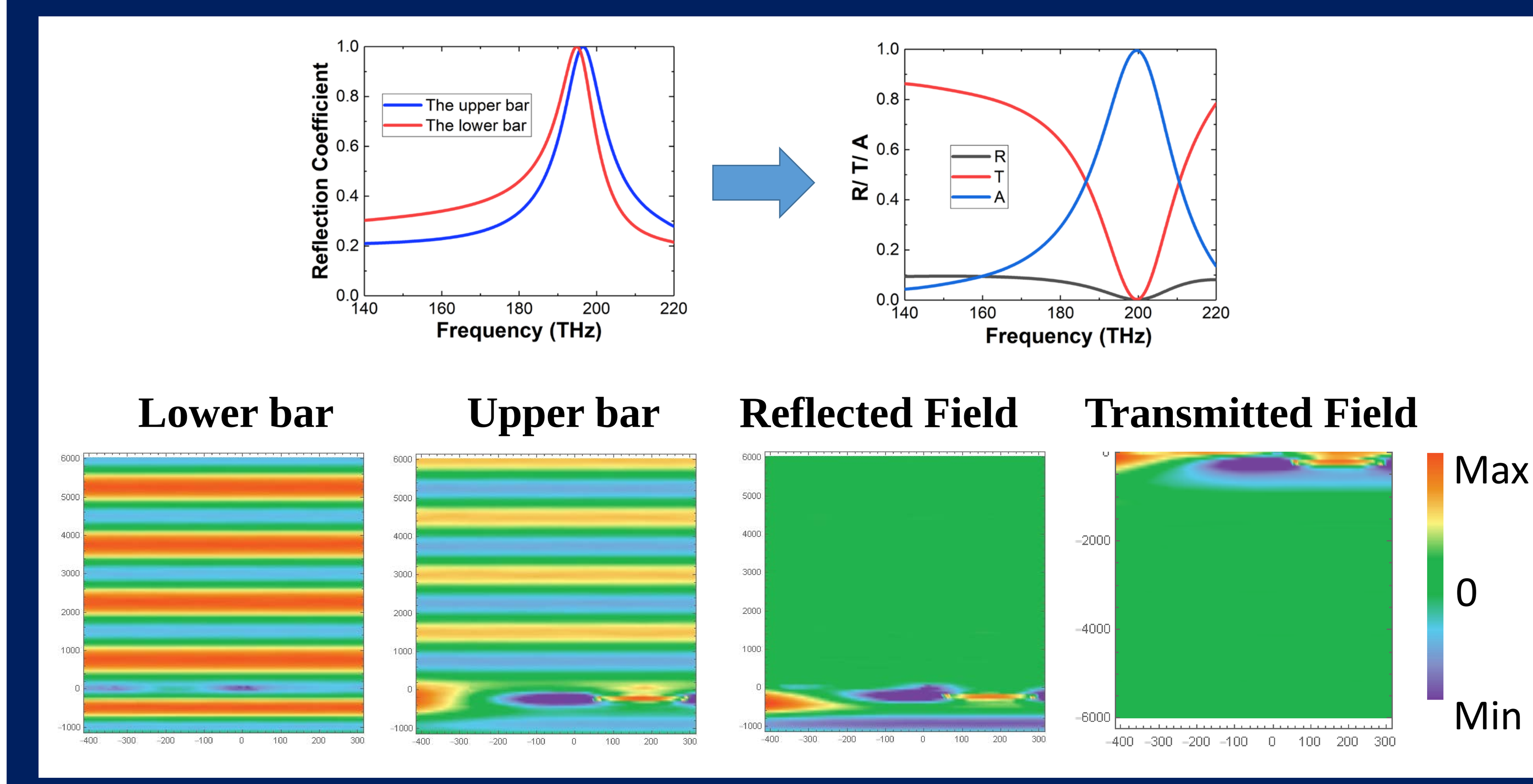
- Functions are always locked and limited due to symmetry in systems.
- Strong reflection occurs outside the absorption band because p and m have different dispersions .

◆ Motivations

- Realize arbitrary regulation of energy between channels.
- Explore a new way to achieve perfect absorption without reflection in broad band.

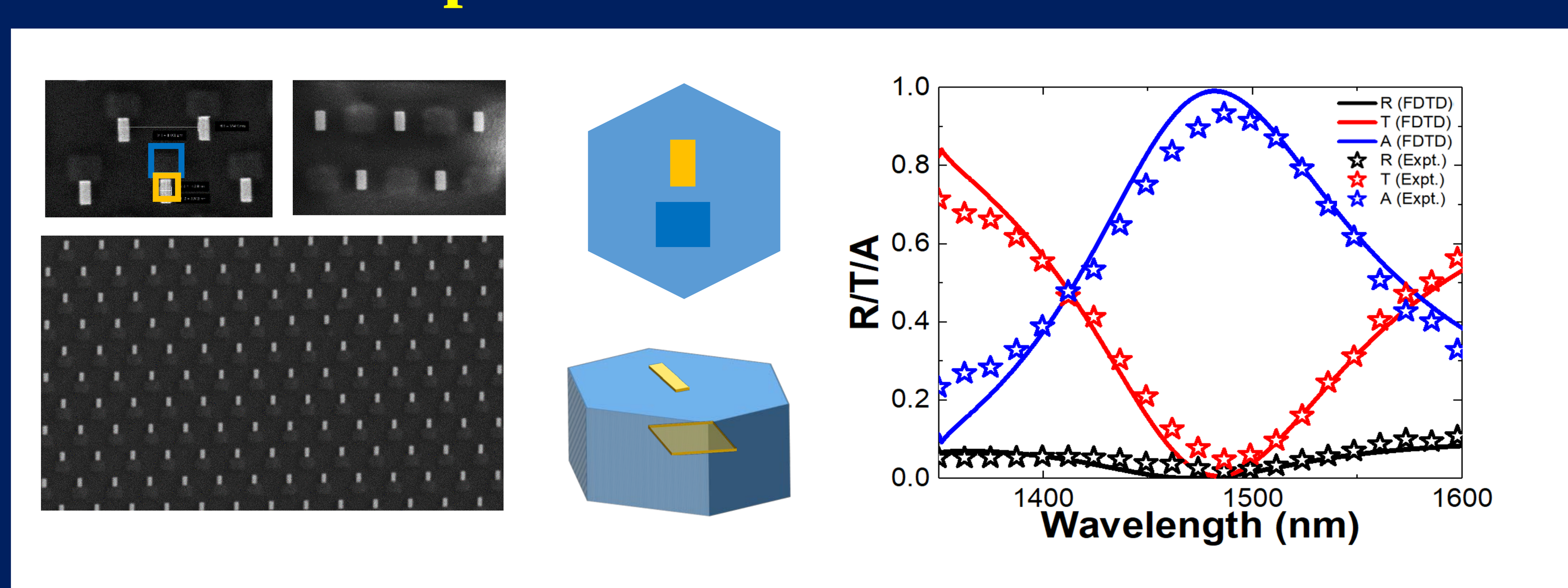


• Simulation Demonstration

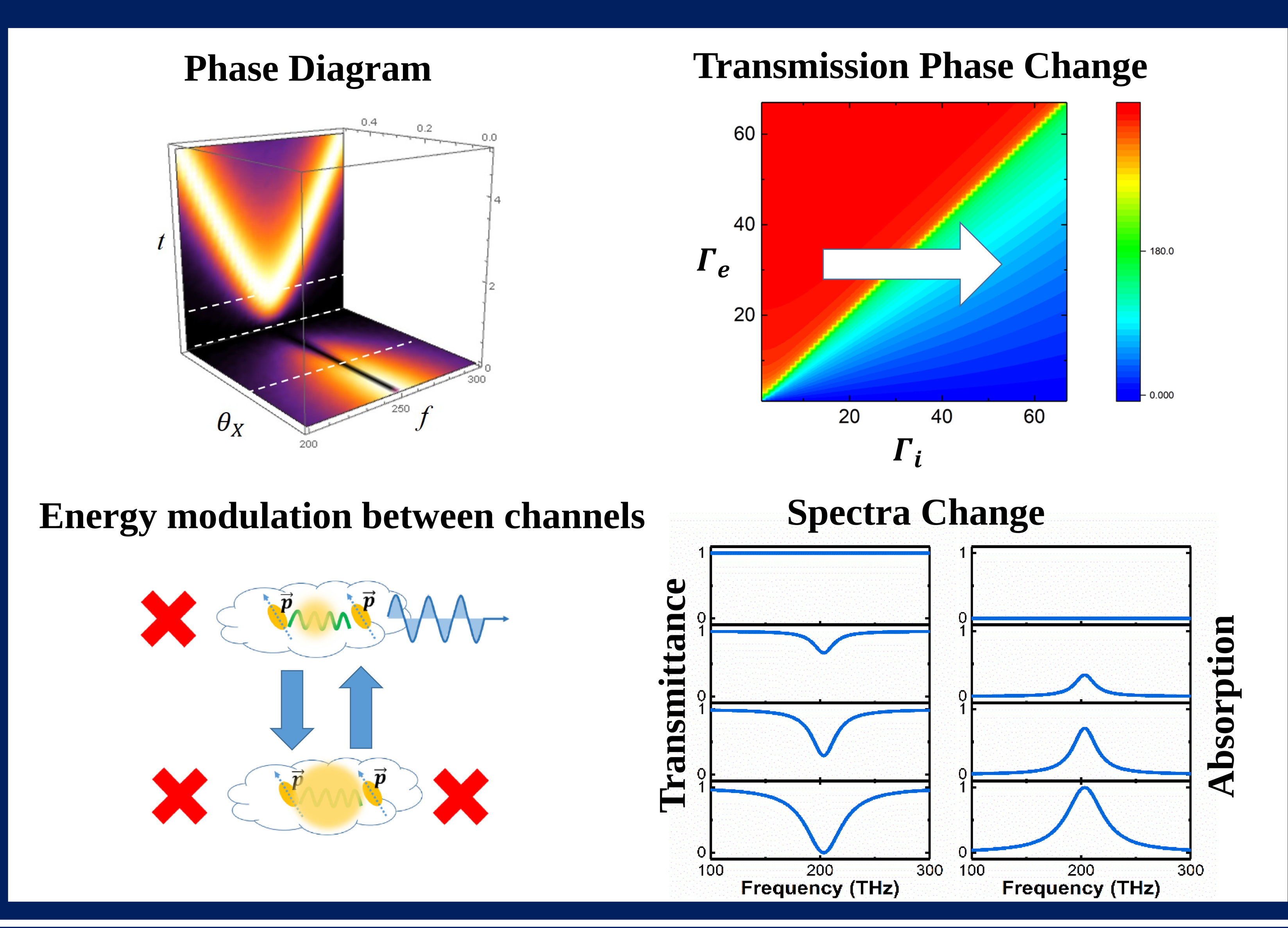


- The upper and lower particles have similar radiation patterns, ensuring similar dispersion in the whole frequency band.
- Phase difference of 180° when the upper and lower layers exist alone creates conditions for destructive interference

• Perfect Absorption and Broadband Non-reflection



• Principles: Coupled Mode Theory

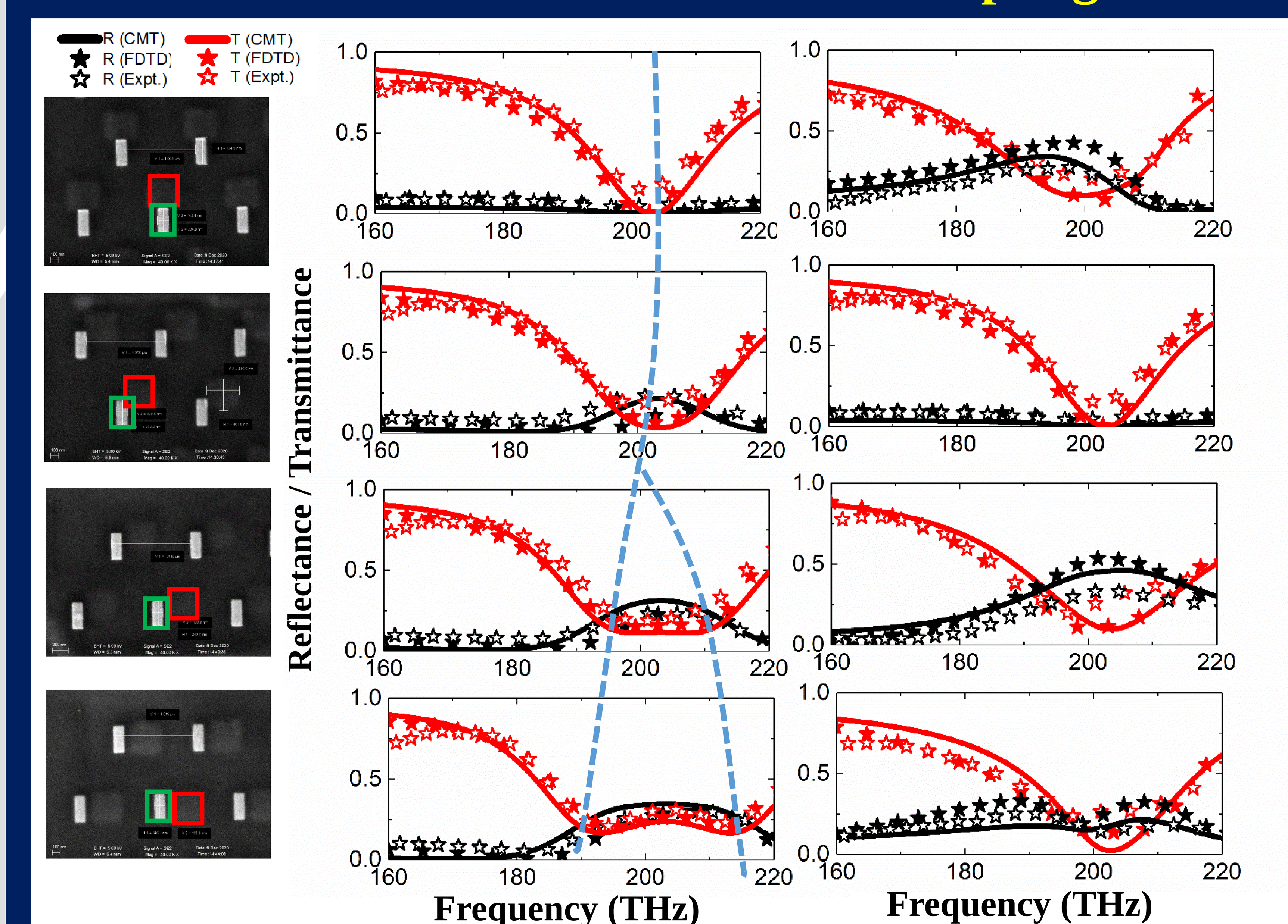


$$-iw\begin{pmatrix}a_1\\a_2\end{pmatrix} = -i\begin{pmatrix}w_0 & t-Im(X)\\ t-Im(X) & w_0\end{pmatrix}\begin{pmatrix}a_1\\a_2\end{pmatrix} + \begin{pmatrix}-\Gamma_e & Re(X)\\ Re(X) & -\Gamma_e\end{pmatrix}\begin{pmatrix}a_1\\a_2\end{pmatrix} + \begin{pmatrix}d_{11}\\d_{12}\end{pmatrix}\begin{pmatrix}S_1^+\\0\end{pmatrix}$$

$$\begin{pmatrix}S_1^-\\S_2^-\end{pmatrix} = \begin{pmatrix}0 & 1\\1 & 0\end{pmatrix}\begin{pmatrix}S_1^+\\0\end{pmatrix} + \begin{pmatrix}d_{11} & d_{12}\\d_{21} & d_{22}\end{pmatrix}\begin{pmatrix}a_1\\a_2\end{pmatrix}$$

- Non-reflection can be realized when near field coupling and far field coupling satisfy certain relationships.
- Free modulation of transmitted and absorbed energy can be realized when we change the absorption parameter.

• Roles of Near-field and Far-field coupling



- Change the horizontal angle: the spectrum gradually split because of the change of the near-field coupling.
- Change the vertical distance: mainly adjust the far-field coupling to make the interference behavior different.

◆ Conclusions:

- We explore a new way to achieve perfect absorption without reflection in broad band, providing an alternative choice for freely modulate energy distribution between channels.
- We reveal the underlying physics of near-field coupling and far-field coupling for diversified promising applications.

References:

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