Polarization-Dependent Characteristic of Bloch Surface Wave Generation : A Comparative Simulation between TE and TM Modes

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Abstract:
Bloch surface waves (BSWs) are electromagnetic surface modes supported at the interface between a photonic crystal multilayer and the surrounding medium, offering low loss and high surface sensitivity for a wide range of optical applications. In this paper, we investigate how the generation of BSWs depends on the polarization of incident light, comparing the transverse electric (TE) and transverse magnetic (TM) modes. Theoretical analysis of electromagnetic boundary conditions and photonic bandgap formation reveals that TE-polarized light produces strong reflection and a wide photonic bandgap, enabling efficient BSW generation. In contrast, TM-polarized light exhibits weaker reflection at the interfaces, resulting in a much less pronounced or even absent BSW. These findings highlight the critical role of polarization in designing BSW-based optical devices and suggest that appropriate polarization control can enhance the performance of BSW sensors, particularly in systems utilizing orthogonal polarization as a reference for noise reduction.

References

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