Frequency-sensitive switching control effect induced by two-photon resonance in an EIT-based layered medium

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Abstract

The optical response of an atomic vapor can be coherently manipulated by tunable quantum interference occurring in atomic transition processes. A periodic layered medium whose unit cells consist of a dielectric and an EIT (electromagnetically induced transparency) atomic vapor is designed for light propagation manipulation. Such an EIT-based periodic layered medium exhibits a flexible frequency-sensitive optical response, where a very small change in probe frequency can lead to a drastic variation of reflectance and transmittance. As the destructive quantum interference relevant to two-photon resonance arises in EIT atoms interacting with both control and probe fields, the controllable optical processes that depend sensitively on the external control field will take place in this EIT-based periodic layered medium. Such a frequency-sensitive and field-controlled optical behavior of reflection and transmission in the EIT photonic crystal can be applicable to designs of new devices such as photonic switches, photonic logic gates and photonic transistors, where one laser field can be controlled by the other one, and would have potential applications in the areas of integrated optical circuits and other related techniques (e.g., all-optical instrumentations).

Keyword：Quantum coherence, quantum interference, EIT-based layered medium, frequency-sensitive