Stimulated Raman scattering with slow light

Kien F.L., Hakuta K.

CREST, Japan Sci. and Technol. Corporation, Kawaguchi, Saitama 332-0012, Japan; Dept. of Appl. Physics and Chemistry, Institute for Laser Science, University of Electro-Communications, Chofu, Tokyo 182-8585, Japan; Department of Physics, University of Hanoi, Hanoi, Viet Nam

Abstract: We study the propagation dynamics of weak Raman sideband fields in a far-off-resonance Raman medium driven by a strong coupling field. We show that the interaction of the system with the strong field, under the conditions of high density, narrow Raman-transition width, and small two-photon detuning, results in a slow group velocity and a substantial enhancement of the injected anti-Stokes sideband field as well as an efficient generation of a Stokes sideband field. We find that the effective group velocity is the same for the two weak fields and is proportional to the field frequency difference instead of the frequency of the corresponding field. We also discuss the condition for exponential growth of the two sideband fields in the medium. We perform numerical calculations for solid hydrogen, a realistic system where the requirements for high density and small Raman width can be met. We demonstrate that the group velocity can be slowed down by several orders, and that the slow light plays a key role for the stimulated Raman scattering process in solid hydrogen.

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Authors with affiliations:

1. Kien, F.L., CREST, Japan Sci. and Technol. Corporation, Kawaguchi, Saitama 332-0012, Japan, Department of Physics, University of Hanoi, Hanoi, Viet Nam
2. Hakuta, K., Dept. of Appl. Physics and Chemistry, Institute for Laser Science, University of Electro-Communications, Chofu, Tokyo 182-8585, Japan

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