HETEROEPITAXY of NLO TERNARY MATERIALS for FREQUENCY CONVERSION DEVICES

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Introduction

High-power, tunable MLWIR sources are in great demand for many applications. Since available direct sources do not satisfy requirements for power and tunability, frequency conversion in NLO materials is suggested. All studied materials, however, have displayed disadvantages or achieved limitations. Instead, exploring new materials, we propose combining the most studied two materials by forming GaAsP ternaries grown heteroepitaxially on orientation-patterned (OP) GaAs templates.

Methods

Prior growing on OP-GaAs templates, thick GaAs1-xPx was grown heteroepitaxially by hydride vapor phase epitaxy on GaAs substrates with composition ranging 0.32–0.93. The samples were characterized to determine compositional dependences of transmission, absorption, refraction, two-photon absorption (2PA) and nonlinear susceptibility. OP-GaAsP with optimized composition (x=25) was then grown on OP-GaAs without encapsulating layer followed by frequency conversion demonstration via SHG.

Results

Growth of 800 μm thick unpatterned GaAsP with high surface/crystalline quality, widened transmission range, lower 2PA than GaAs but higher nonlinear susceptibility than GaP at 1.0–1.7 μm achieved, also 500 μm thick OP-GaAsP on OP-GaAs templates with excellent domain fidelity and periods between 30–124 μm (Fig1). SHG at 5.45 μm with 11 % conversion efficiency demonstrated [1].

Conclusions

Heteroepitaxy of GaAsP/GaAs resulted in high layer quality. Forming ternaries allowed optimizing NLO properties, patterns with wider domains, using pump sources from the telecommunication band. Growth of OP-GaAsP/OP-GaAs demonstrated that templates without encapsulating layer provide conditions for uniform layer nucleation. Demonstrating efficient SHG in the MIR OP-GaAsP makes heteroepitaxy and ternaries preferred approaches in development of frequency conversion sources for MLWIR.