High-Precision three-dimensional photonic crystals using micro transfer-printing technique

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Three-dimensional (3D) integration of photonic crystals (PhCs) is expected to be necessary to form a successful optoelectronic device. Since the 3D PhCs light source has a complete photonic band gap, it has remarkable optical properties that confine light propagation in all directions.[1] So far, such schemes have been pursued by embedding artificial defects inside the crystals, making use of 3D band gap directional effects. Also, 3D PhCs can be fabricated by stacking layers with nanometer thickness one by one. However, the fabrication of such 3D structures still remains a challenge, involving manual stacking of 2D structures with precise alignment requirements.

Therefore, we propose a new platform for stacking technique of ultra-small devices for development of original technology and light sources integrated into optical integrated circuits. We noted that the micro transfer-printing techniques using soft polymer microtip do not destroy samples. Also, we developed a cost-effective and versatile OM microtip technique that can smoothly approach the photonic device to the pre-produced Si guide and transfer it. In addition, through this technique, Si 3D PhCs designed as a laser device by inserting a layer of optical gain material can be fabricated in precision.

References

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