ARTICLES

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Tubular/helical architectures construction based on rolled-up AlN nanomembranes and resonance as optical microcavity

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Abstract: Aluminum nitride (AlN) has attracted a great amount of interest due to the fact that these group III–V semiconductors present direct band gap behavior and are compatible with current micro-electro-mechanical systems. In this work, three dimensional (3D) AlN architectures including tubes and helices were constructed by rolling up AlN nanomembranes grown on a silicon-on-insulator wafer via magnetron sputtering. The properties of the AlN membrane were characterized through transmission electron microscopy and X-ray diffraction. The thickness of AlN nanomembranes could be tuned via the RIE thinning method, and thus micro-tubes with different diameters were fabricated. The intrinsic strain in AlN membranes was investigated via micro-Raman spectroscopy, which agrees well with theory prediction. Whispering gallery mode was observed in AlN tubular optical microcavity in photoluminescence spectrum. A postprocess involving atomic layer deposition and R6G immersion were employed on as-fabricated AlN tubes to promote the Q-factor. The AlN tubular micro-resonators could offer a novel design route for Si-based integrated light sources. In addition, the rolled-up technology paves a new way for AlN 3D structure fabrication, which is promising for AlN application in MEMS and photonics fields.

Key words: AlN nanomembranes; rolled-up technology; helices; optical microcavity

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Supporting Information

1. Element Mapping of ALN membrane

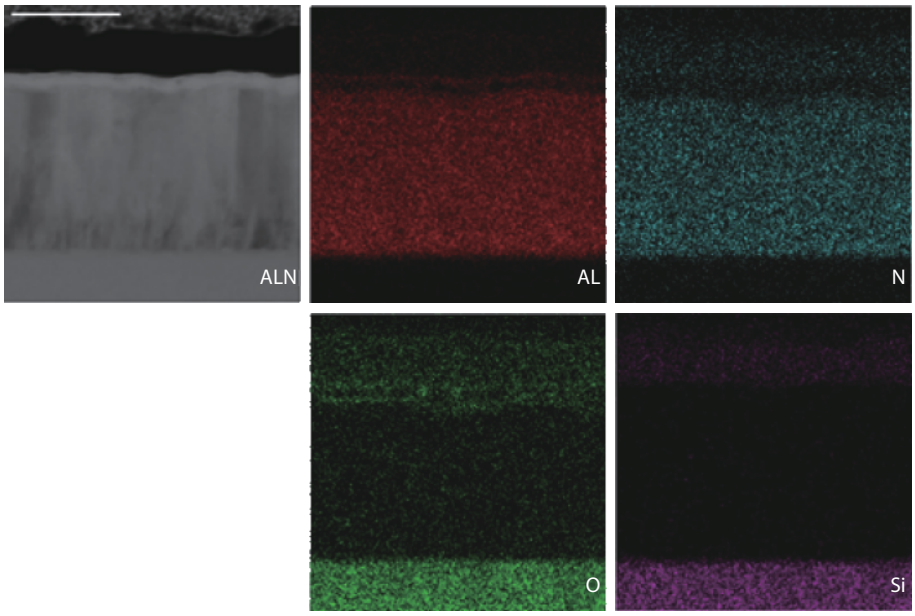

Fig. S1. (Color online) Element mapping of ALN membrane (scale bar = 50 μm).

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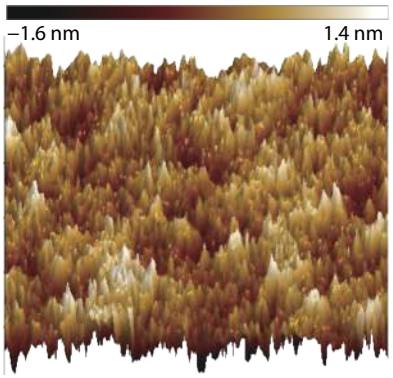

Fig. S2. (Color online) AFM characterization.

2. The morphology of ALN membrane characterized by AFM