Supplementary Information

Nanoradio utilizing mechanical resonance of a vertically aligned nanopillar array

Chang Hwa Lee[1], Seok Woo Lee[2,*], and Seung S. Lee[2]

[1]*The 3rd R&D Institute, Agency for Defense Development (ADD), Yuseong P.O.Box 35, Daejeon, 305-600, Korea*

[2]*Department of Mechanical Engineering, Korea Advanced Institute of Science and Technology (KAIST), 373-1 Guseong-dong Yuseong-gu, Daejeon, 305-701, Korea*

Supplementary Information

1. **The fabrication process of nanopillar array and SEM images**
2. **Numerical analysis of diffracted light intensity**
3. **A schematic view and an image of the experimental setup**

Figures S1, S2, S3

Movie S1

* S. W. Lee to whom correspondence should be addressed. Electronic mail: swlee81@kaist.ac.kr

The fabrication process of nanopillar array and SEM images

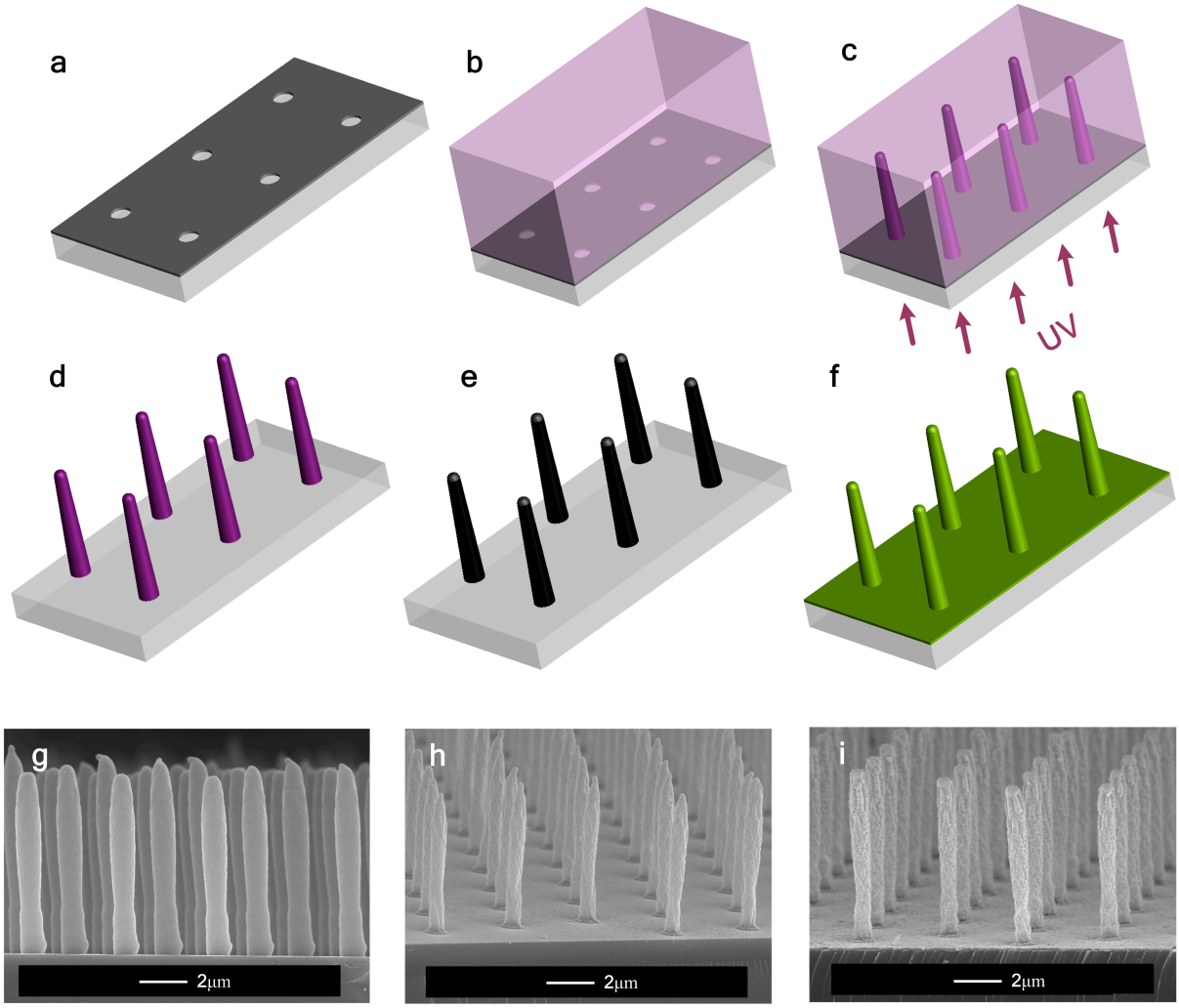

Figure S1 | The fabrication process of nanopillar array and SEM images. d, g, The nanopillar array of cured SU-8. **e, h,** The nanopillar array of pyrolyzed carbon. **f, I,** The nanopillar array coated with a 0.1-μm-thick ITO layer.

1. **Numerical analysis of diffracted light intensity**

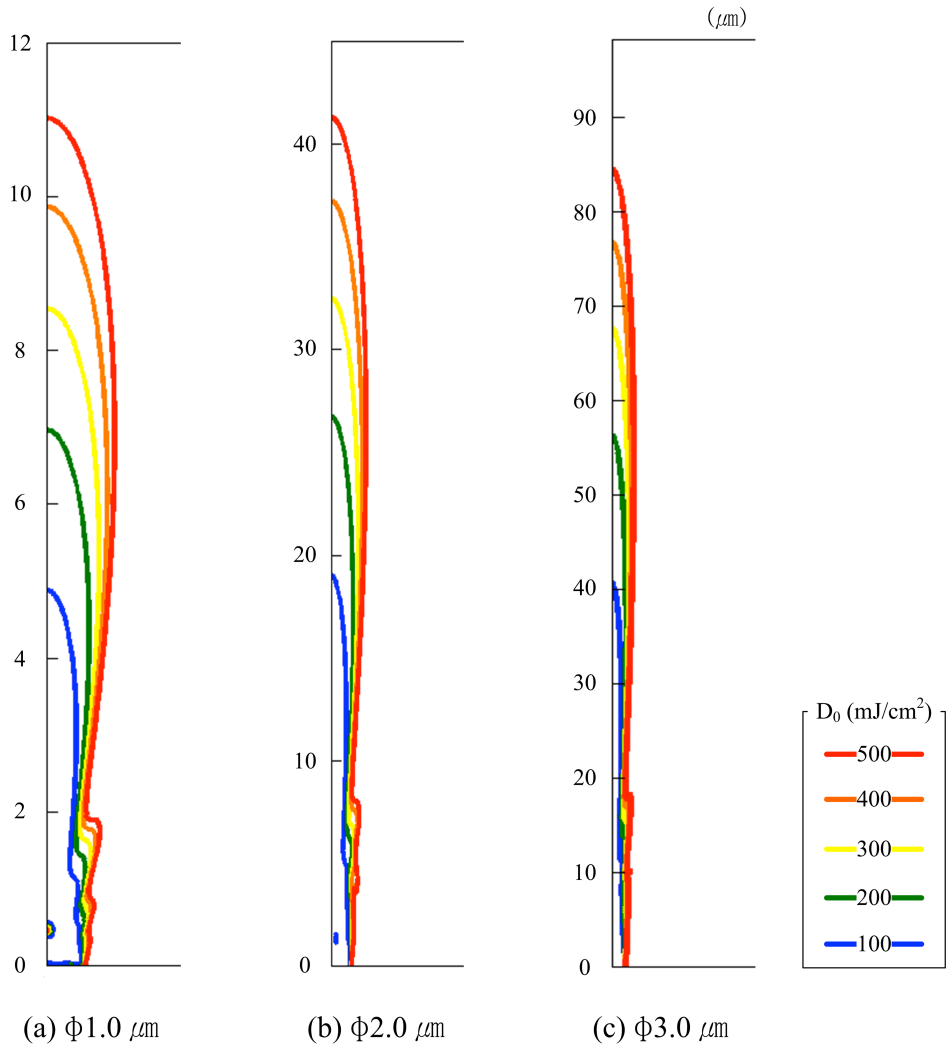

Figure S2 | Numerical analysis of diffracted light intensity based on Huygens-Fresnel diffraction principle.

In order to estimate the shape of the photoresist nanopillar fabricated by backside exposure lithography process, numerical analysis is examined for various conditions of diameter of the aperture and the exposed dose as we presented previously (S1). The exposed dose is varied from 100 to 500 mJ cm^{-2} and the diameters of the circular apertures are 1, 2, 3 ㎛, respectively. As shown in Figure S2, the height of the nanopillar which the diameter of the circular aperture is 1 ㎛ is increased from 5 to

11 μm as exposed dose is increased from 100 to 500 mJ cm^{-2}. When the diameters of the circular apertures are 2 and 3 μm, the height of the tip are increased from 19 to 42 μm and from 41 to 85 μm as exposed dose is increased from 100 to 500 mJ cm^{-2}, respectively. Using this method, precise processes condition, such as aperture diameter and exposed dose in photolithography, are determined for proper height and width of nanopillar structures having a designed mechanical resonance behavior.

2. A schematic view and an image of the experimental setup

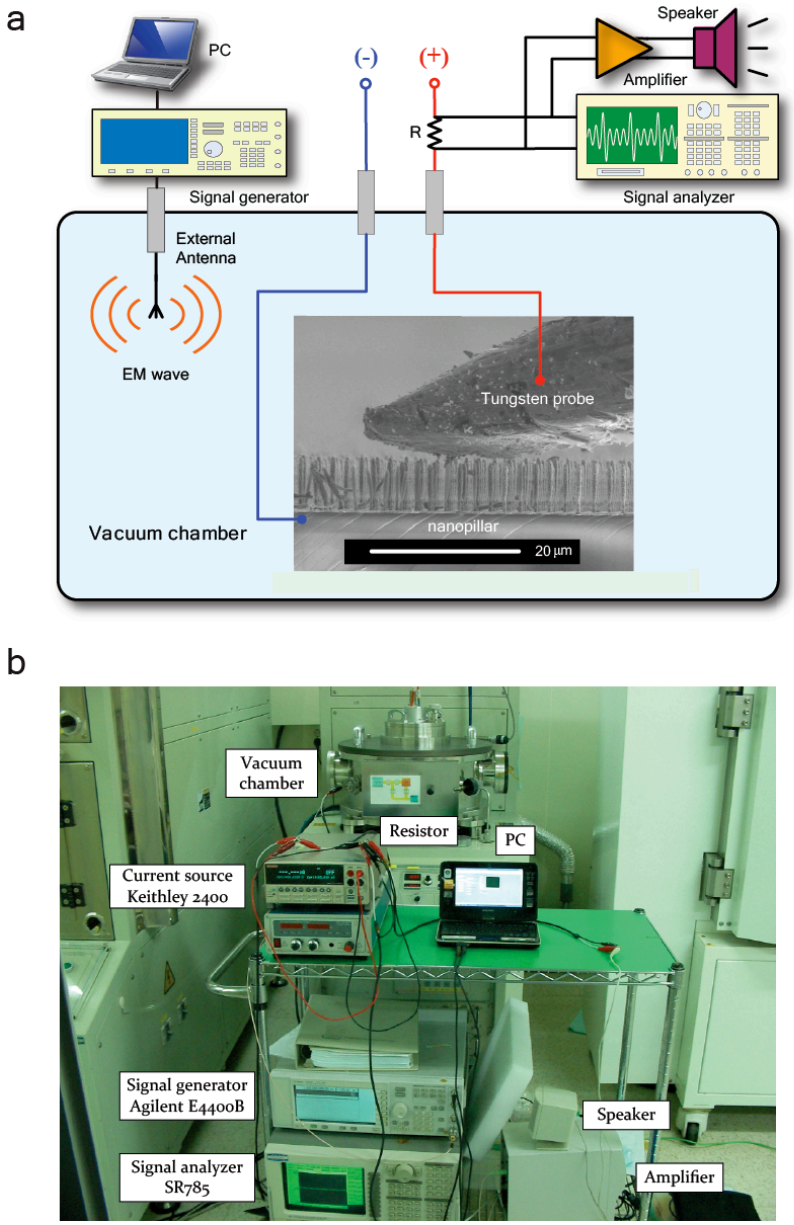

Figure S3 | A schematic view and an image of the experimental setup. a, A schematic view of the experimental setup for the field emission characteristics and the nanopillar array radio. **b,** An image of the experimental setup. In the video, the current source is replaced by batteries.

Reference

(S1) S. W. Lee, S. S. Lee, Opt. Lett., 33, pp. 40, 2008.