Supplementary Information

Giant Enhancement of Raman Response Due to One-Dimensional ZnO Nanostructures

Hae-Young Shin [a], Ee Le Shim [b], Young-Jin Choi[c], Jong-Hyurk Park* [d], and Seokhyun Yoon*[a]

[a]*Department of Physics, Ewha Womans University, Seoul, 120-750, Korea*
[b]*School of Mechanical & Automotive Engineering, Halla University, Wonju, 220-712 Korea*
[c]*Department of Physics, Myoung-Ji University, Yongin, 449-728,. Korea*
[d]*Electronics and Telecommunications Research Institute.(ETRI), Daejeon 305-700, Korea*

Synthesis of ZnO nanowires and nanocones

For our experiments using ZnO nanowires, first, a ZnO seed layer with the thickness of 50 nm is deposited on a Si substrate by radio-frequency (RF) magnetron sputtering. To obtain a good crystalline property of the seed layer, it is annealed at 500℃. The growth solution was prepared at 15 mM by dissolving zinc nitrate hexahydrate (98%, Aldrich) and hexamethylenetetramine (HMTA) (99%, Aldrich) in deionized water. Then, the substrates were suspended upside-down in a glass bottle filled with the growth solution for 6 hours at 80 ℃ to grow ZnO nanowires on the seed layer. Due to the growth direction of the seed layer ([0001] or [0002]), ZnO nanowires are also grown vertically with the same direction. ZnO nanocones are formed by the chemical etching technique with HCl with a pH of 4.0 at room temperature for 30 s, since the atomic binding energy along a- and c-axis of ZnO is different. After the reaction, substrates were rinsed for 10 min with DI water and oven-dried at 100 ℃ for 30 min.

Sample Structures for Raman scattering measurements

For Raman measurements, we prepared three different samples, S1, S2, and S3 as shown in Fig. S-1. In S1, only the ZnO seed layer was deposited on top of a Si substrate. In S2, ZnO nanowires were grown on a substrate that has the same structure as S1. In S3, ZnO nanocones converted from ZnO nanowires on a substrate that has the same structure as S1.

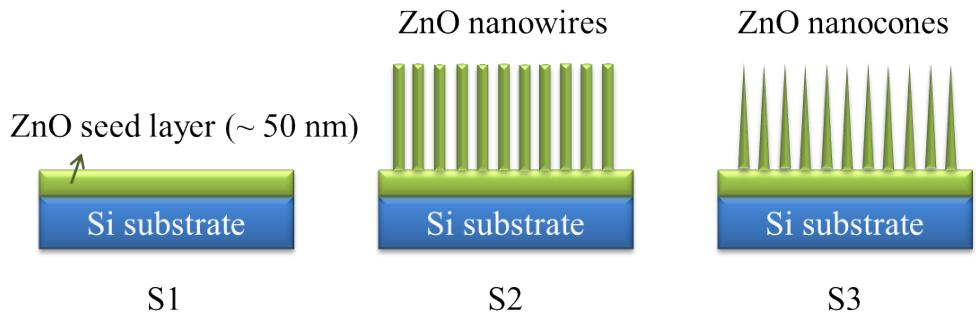

Figure S-1. Three differently prepared samples. S1 is ZnO thin film seed layer only, S2 is ZnO nanowires grown on a substrate with the same structure as S1, and S3 is ZnO nanocones grown on a substrate with the same structure as S1.

Raman scattering measurements

1. Macro Raman scattering measurements

Room temperature Raman scattering spectra of ZnO nanowires and nanocones were measured by using a McPherson 207 spectrometer equipped with a nitrogen-cooled charge-coupled-device (CCD) array detector. The samples were excited with a 488 nm diode laser, focused to ~100 μm diameter spot using a achromat lens. The excitation power was 0.5 mW to avoid laser heating.

2. Micro Raman scattering measurements

Room temperature micro-Raman scattering spectra of ZnO nanowires and nanocones were also measured by using a Horiba Jobin Yvon high resolution dispersive Raman microscope equipped with a thermoelectric-cooled charge-coupled-device (CCD) array detector. The samples were excited with a 785 nm diode laser and a 514.5 nm and 488.8 nm Ar^+ ion laser, focused to ~1 μm diameter spot using a microscope objective (x100). The excitation power was 0.01 mW.