Synthesis of Monodispersedly Sized ZnO Nanowires from Randomly Sized Seeds

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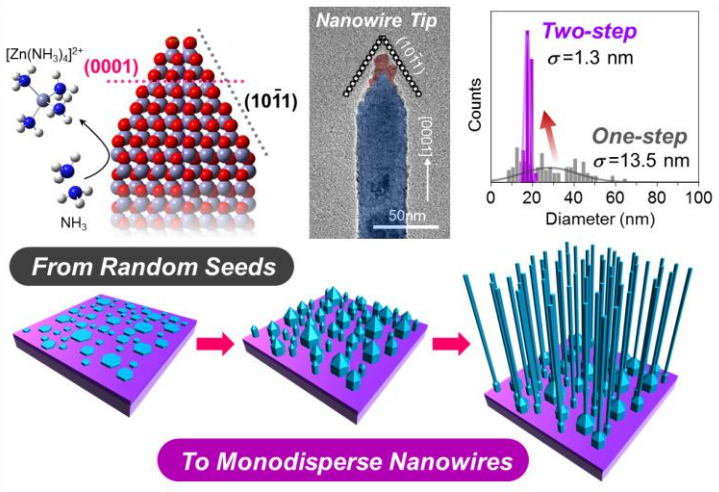
Spontaneously assembled (i.e., bottom-up grown) metal oxide nanomaterials are a rapidly expanding research topic in both fundamental sciences and interactive nanodevice applications due to their intriguing properties and their high thermal and chemical robustness. In bottom-up nanomaterials synthesis, structural control is the most fundamental challenging issue. This is because the electrical, optical, and mechanical properties of nanostructured materials are strongly influenced by their geometry. Many previous studies consistently showed the crucial importance of a homogeneously sized initial nucleation to obtain the monodisperse nanowires. For controlling the initial nucleation, a seed prepatterning approach on substrate that defines the seed size has been demonstrated via different lithographic techniques. However, these techniques are very costly and restricted to operation in limited areas.

Here we demonstrate the facile, rational synthesis of monodispersedly sized zinc oxide (ZnO) nanowires from randomly sized seeds by hydrothermal growth. Uniformly shaped nanowire tips constructed in ammonia-dominated alkaline conditions serve as a foundation for the subsequent formation of the monodisperse nanowires. By precisely controlling the sharp tip formation and the nucleation, our method substantially narrows the distribution of ZnO nanowire diameters from σ = 13.5 nm down to σ = 1.3 nm and controls their diameter by a completely bottom-up method, even initiating from randomly sized seeds. The proposed concept of sharp tip based monodisperse nanowires growth can be applied to the growth of diverse metal oxide nanowires and thus paves the way for bottom-up grown metal oxide nanowires-integrated nanodevices with a reliable performance.



References

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