SUPPORTING INFORMATION

Parametric study on controllable growth of ZnO nanostructures with tunable dimensions using catalyst-free metal organic chemical vapor deposition

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Time-dependent experiments of the ZnO nanowall networks structures

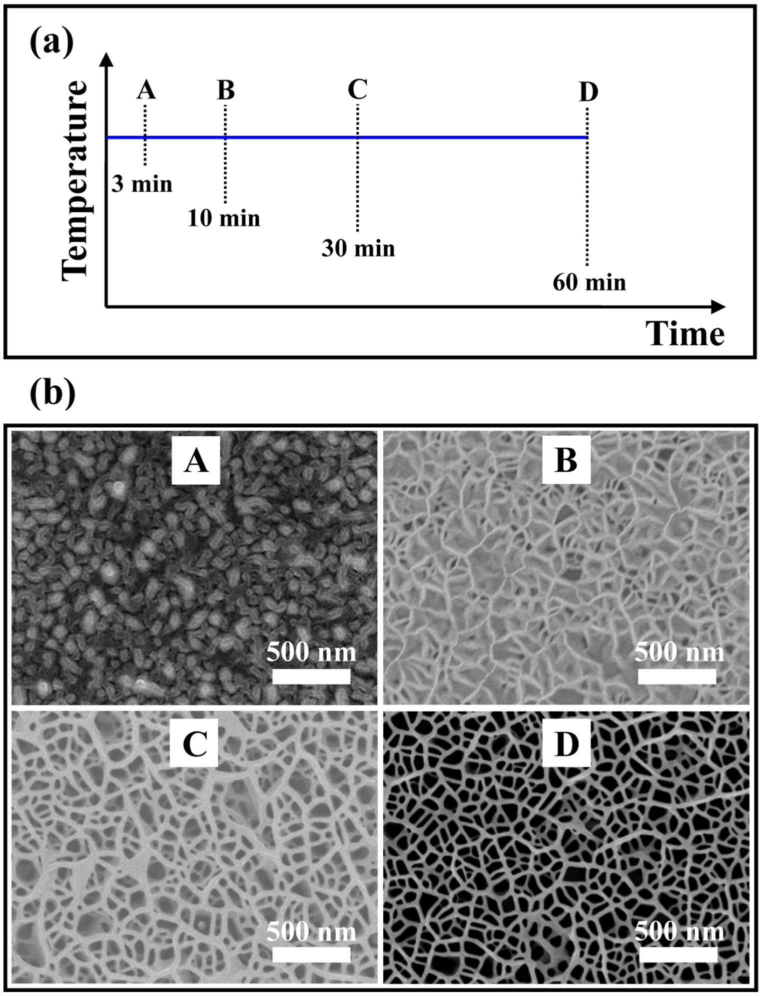

FIG. S1. (a) Schematic representation of the growth process at different growth stages. (b) Morphology evolution of the ZnO products at different growth stages.

In our experiment, the growth model of ZnO nanostructures could be controlled by changing the growth parameters in appropriate windows. However, to determine why the ZnO products behaved such morphologies, it was necessary to fully understand the thermodynamic process of ZnO nanostructure and the morphology evolution of ZnO at different growth stages. Take the ZnO nanowall networks as an example, we carried out the time-dependent experiments to monitor the evolution of ZnO morphology at different growth stages based on the growth conditions of sample K. As shown in Fig. S1(a), we prepared four samples at different growth stages and their corresponding SEM images were presented in Fig. S1(b).

At the initial stage (3 min, A), an uniformly distributed crystal nucleus favored the formation of small *c*-plane ZnO grains with high density. Note that the formed crystallites appeared wormlike shape, which regularly arranged on the substrate. It can be speculated that rough and striped grains at the surface initiated and activated the formation of bridges among neighboring grains as the growth proceeded (10 min, B), and the followed growth will be guided by the existing network surface. Finally, the shapes of ZnO products (C, D) resembled those of networks obtained in the beginning.

As can be noted in Fig. S1(b), the formation of bridges was the key for the growth of well-aligned nanowall networks. Detailed reasons for such argument could be elucidated briefly as follows. The growth at the initial stage resulted in a rough ZnO surface, convex and concave regions can be formed because of the insufficient grain coalescence process. The humps at the head of striped grains may act as activation sites for the formation of bridges due to high surface energy than that of valleys. And the ZnO tended to grow at the convex regions to reduce the local surface energy. It was reasonable because there was often a higher density of dangling bonds at the convex regions, and meanwhile, the humps had a bigger superiority to adsorb the reactant sources because of height difference. Thus, the ZnO growth along the existing network surface was facilitated and well-aligned nanowall networks were achieved finally.