Growth of metal oxide semiconductor microcrystals by optical vapor supersaturated precipitation: mechanism, equipment and applications

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Metal oxide semiconductors (MOS) with direct and wide bandgaps are of importance as multifunctional materials due to their unique physical and chemical properties. The regular morphologies of MOS microcrystals open new opportunities to boost photons interacting with excitons/electrons for exciton-polariton, spontaneous radiation amplification, *etc*. Unfortunately, the major challenge to develop the novel devices is growth of MOS with a variety of regular microstructures. In 2017, we first reported a technique, named optical vapor supersaturated precipitation (OVSP), to grow single-crystal ZnO microtubes, in which a number of new phenomena were revealed in photon-exciton interactions [1]. After that, the OVSP technique was further developed for MOS microcrystals with various properties and morphologies. Here we first introduce the mechanism of OVSP for growth of MOS microcrystals with varied microstructures, for which the in-house developed equipment is exhibited [2, 3]. The OVSP technique has demonstrated the superior capability to control defects and dope ions during growth of ZnO, by which a variety of applications are achieved, including current-induced thermal tunneling electroluminescence [4, 5], homojunction photodiode for UV detection [6, 7], heterojunction for photocatalysis [8], memristor [9], graphene-oxide-modified antibacterial agents [10], etc., in which the contribution of OVSP growth process to material properties are revealed. In addition, the $In_2O_3(ZnO)_m$ (IZO) superlattice microplates are achieved [11]. The unique anisotropic electrical properties of the IZO superlattice microplates are manifested, for the first time. The present works open up new opportunities to fabricate a variety of MOS microcrystals for new insight into novel optoelectronic devices for future applications.

References

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