Simple synthesis of ultra-high quality $\text{In}_2\text{S}_3$ thin films on InAs substrates

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— We report a simple and reliable technique to synthesize high-quality $\text{In}_2\text{S}_3$ films on device-ready substrate, such as InAs substrates for useful device applications, by using thermal sulfurization in a hot-wall tube furnace. The crystal structure and composition were studied by using X-ray diffraction and energy dispersive X-ray, and the results confirmed that the synthesized $\text{In}_2\text{S}_3$ films were cubic $\beta$-$\text{In}_2\text{S}_3$ or tetragonal $\beta$-$\text{In}_2\text{S}_3$, depending on growth conditions. Morphology, vibrational modes, and optical properties were investigated by using field emission scanning electron microscopy, Raman, and photoluminescence spectroscopy, and the results indicated that the $\text{In}_2\text{S}_3$ films are remarkable crystal quality with substantial efficiency in photoluminescence. Especially, by optimizing the growth conditions, we have grown an extremely high-quality tetragonal $\beta$-$\text{In}_2\text{S}_3$ thin film firmly remained on the InAs substrate, for the first time.

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