Interplay between crystal structure and optical response in Plateau–Rayleigh Zn_2GeO_4/SnO_2 heterostructures

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Hybrid semiconductor nanowire architectures are crucial building blocks for novel optoelectronic nanodevices [1]. Among the different synthesis routes, the Plateau-Rayleigh crystal growth is an unique approach to obtain decorated nanowires with specific morphological features [2]. Owing to the critical role of cluster and secondary phases in their performance, it has become a challenge to investigate correlatively the elemental composition, structural order and optical response of these decorated nanowire systems with nanometer resolution. Usually, electron microscopies are applied to address such issues in representative sample volumes [3]. Here, using a synchrotron nanoprobe, we show a concomitant spatially-resolved nano-analysis of the crystal symmetry, chemical and optical properties of a full Zn_2GeO_4/SnO_2 nanowire-heterostructure formed by Plateau-Rayleigh instability [4]. Our measurements reveal the composition of the crystallites decorating the nanowire (Zn doped $Sn_{1-x}Ge_xO_2$) and suggest a connection between the Zn impurities, the formation of a secondary phase and the asymmetrically distributed UV emission. The present work shed light on the role of elemental diffusion, secondary phases and atomic site configurations behind the light emission mechanisms in these hybrid architectures. These underlying mechanisms are critical to meet engineering challenges to tailor the distinctive emergent properties and to create novel complex nanodevices based on one-dimensional materials.

References

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