Distributed Bragg Reflectors Entirely Based on BN Fabricated in a Single MOCVD Process

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Boron nitride (BN) layers with sp^2 orbital hybridization are promising candidates to be applied in flexible electronics [1] or as substrates for other 2D materials [2]. High-quality sp^2-type BN layers are achieved either by Flow Modulation Epitaxy (FME), where the precursor gases are introduced in the reactor chamber in an alternating manner, or by the combination of FME with Continuous Flow Growth [3]. These approaches often utilize high growth temperatures (>1200 ºC) as well as significant chamber pressure and ammonia flow rates multiple times greater than those of the boron precursors.

However, another growth regime arises for temperatures lower than 1000 ºC, chamber pressures not exceeding 100 mbar and ammonia flow rates comparable to those of the boron sources [4]. In this regime, the fabrication of thick BN layers with tunable refractive index values can be achieved.

In this communication, we show that two types of BN layers with high refractive index contrast can be deposited alternately on top of each other (Fig. 1a,b) to fabricate a Distributed Bragg Reflector (DBR). By changing the deposited BN layer thickness, we can tune the position of the reflectance maximum in the visible and IR parts of the electromagnetic spectrum. For a DBR structure consisting of 15.5 layer pairs, the achieved reflectance maximum reaches 90% (Fig 1c) [5]. This value may be increased via further optimization of the growth parameters.

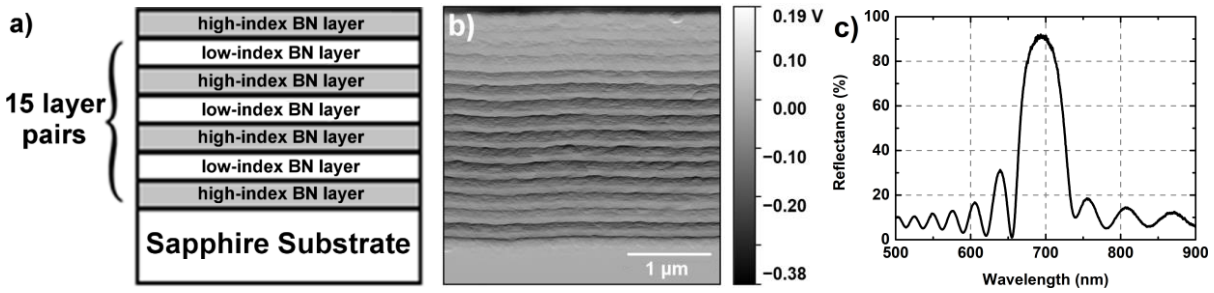

Fig. 1 a) schematic of the fabricated DBR, b) cross-sectional AFM amplitude scan of a sample fabricated DBR, c) reflectance spectra of the DBR optimized for 693 nm.

Fabricating the whole DBR in a single MOCVD process provides prospects for more complex structures, where an active material (e.g. a single photon emitter [6]) is deposited in the cavity of two DBR structures. More examples will be further discussed.

This research was funded by the National Science Centre, grants no. 2019/33/B/ST5/02766 and 2020/39/D/ST7/02811.

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