**Supplementary**

# New Process for Stabilization of Vertically Aligned $GdB_6$ nanorods and their Field Emission Properties

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The Si- substrate utilized for the $GdB_6$ film fabrication was cleaned with acetone, water, isopropanol, HF and Piranha solutions. First, Si-substrate introduced in preheated acetone at 50 $^0$C for 30 min and then cleaned with water and isopropanol. In the second step, piranha solution (3:1 volume ratio of 98 % $H_2SO_4$ and 30 % $H_2O_2$) was heated at 80 $^0$C, when bubbles evolve at the surface of the solution, the cleaned substrate introduced in the solution for 10 min followed by cleaned with water. In the last step, the substrate has been cleaned with HF and then washed with water, followed by isopropanol washing.

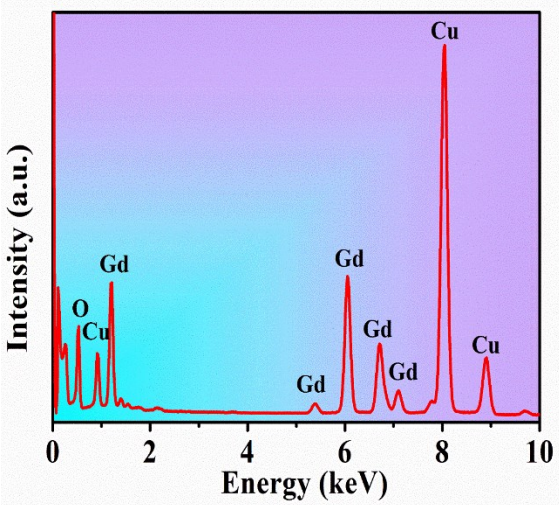


**Fig. S1.** EDX of $Gd(OH)_3$

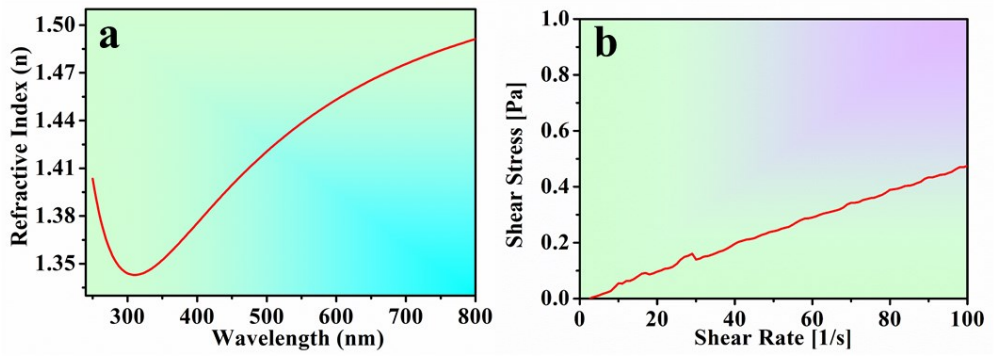


**Fig. S2.** (**a**) Refractive index of $GdB_6$, (**b**) Viscosity of prepared ink

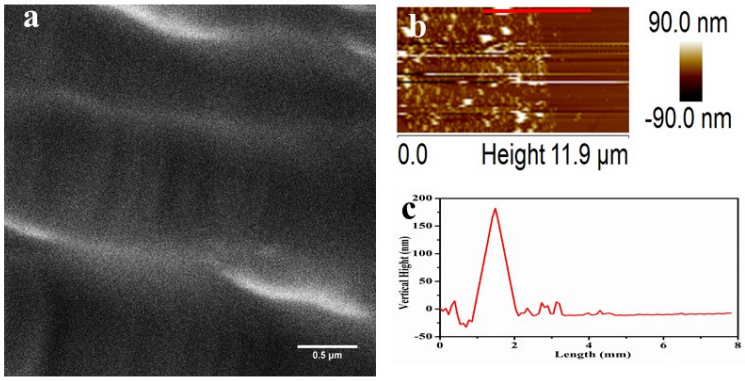


**Fig. S3**. (**a**) cross-sectional SEM of $GdB_6$ film, (**b-c**) AFM study for high profile

**Synthesis of $GdB_6$ nanocubes and their field emission**

In the present study, for the synthesis of $GdB_6$ nanocubes, $Gd(OH)_3$ nanorods and $NaBH_4$ were mixed in 1:20 molar ratio and annealed in the presence of argon at 1000 ℃ for 8 h at a heating rate of 250 ℃/h. The PXRD study of the as-obtained sample has been shown in **Fig. S4a**. All the diffraction pattern matched with $GdB_6$ having JCPDC card number 03-065-1826 with cubic space group (Pm-3m). Further, the TEM study reveals the formation of the irregular cubic particle of size 30-50 nm (**Fig. S4b**). As prepared $GdB_6$ nanocubes were further deposited on Si- substrate via spin coating method followed by slow drying. The AFM study of $GdB_6$ film show that the cubes are agglomerated (**Fig. S4c**). Further, the fabricated $GdB_6$ film has been utilized for the field emission study. J vs E plot of $GdB_6$ film fabricated using $GdB_6$ nanoparticles is shown in **Fig. S4d.** The observed turn-on field was ~5.3 V/µm. The F-N plot

(ln $J/E^2$ vs 1/E) shows the linear plot at high field, confirms that the emission occurs due to tunnelling of energy barrier when the external electric field applied. However, the observed current density of $GdB_6$ film fabricated using $GdB_6$ nanocube was much lower than $GdB_6$ nanorods (**Fig. S4d**).

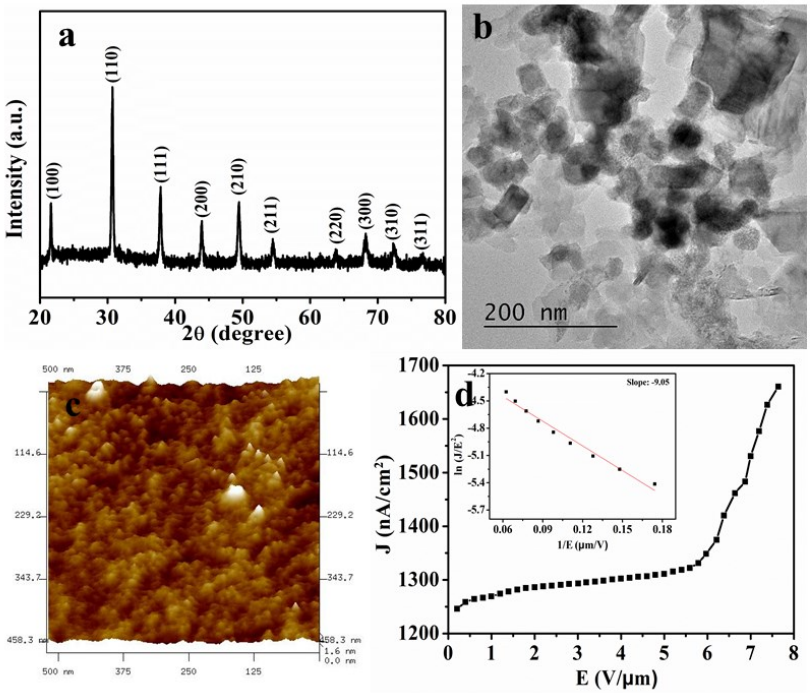


**Fig. S4.** (**a**) PXRD of $GdB_6$ nanoparticles, (**b**) TEM study of $GdB_6$, (**c**) AFM study of $GdB_6$ nanocubes, (**d**) field emission study of $GdB_6$ nanocubes (inset F-N plot)