

Supporting Information

Water flow and finger-tapping mediated piezoelectric energy generation using natural hematite-based flexible PVDF-HFP membrane

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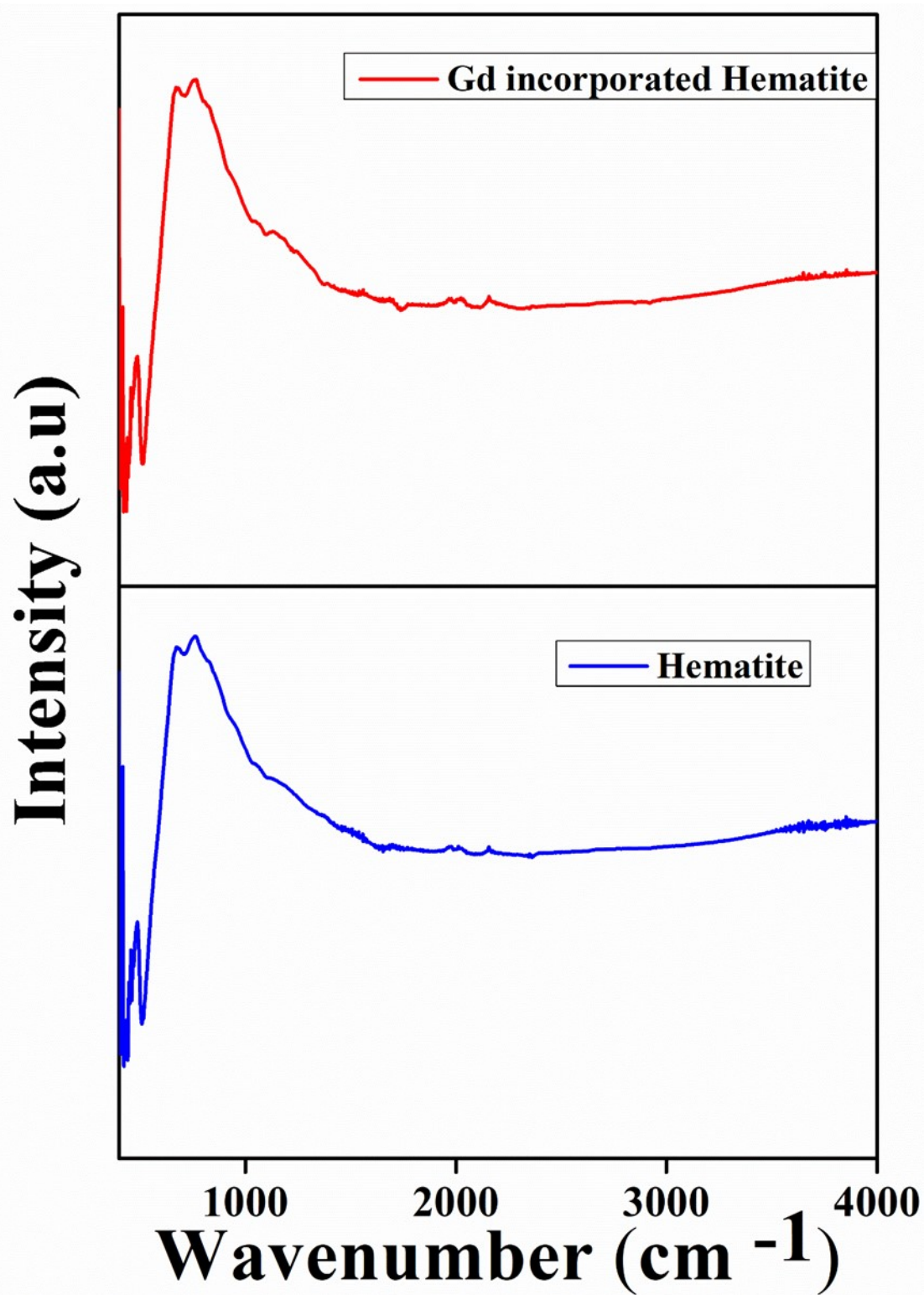
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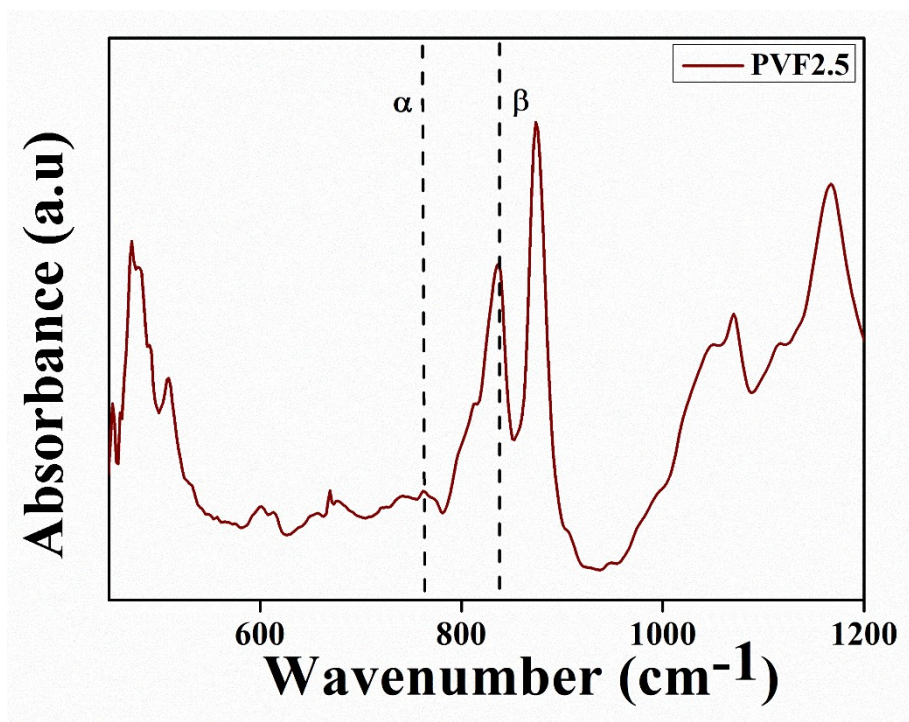
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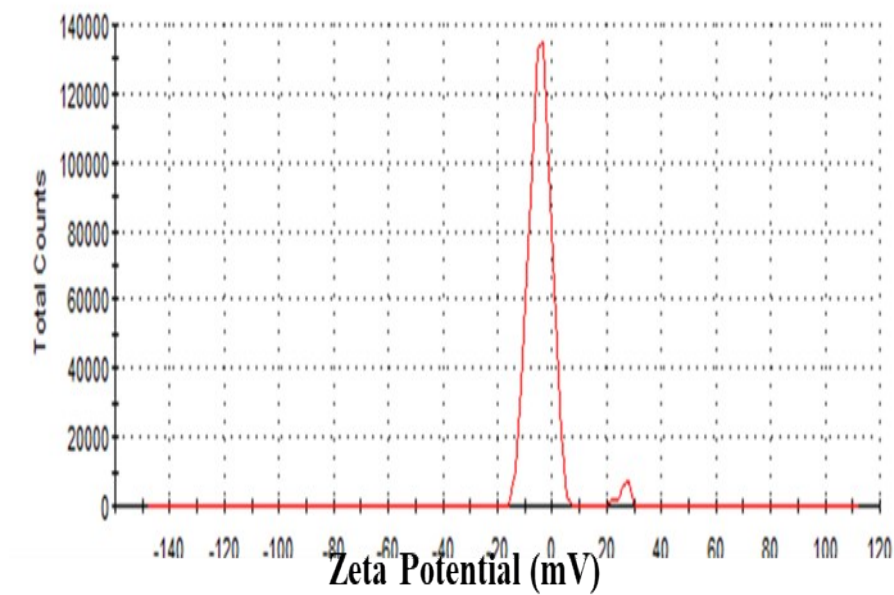
S1: FTIR of Hematite and Gd incorporated hematite nanoparticles



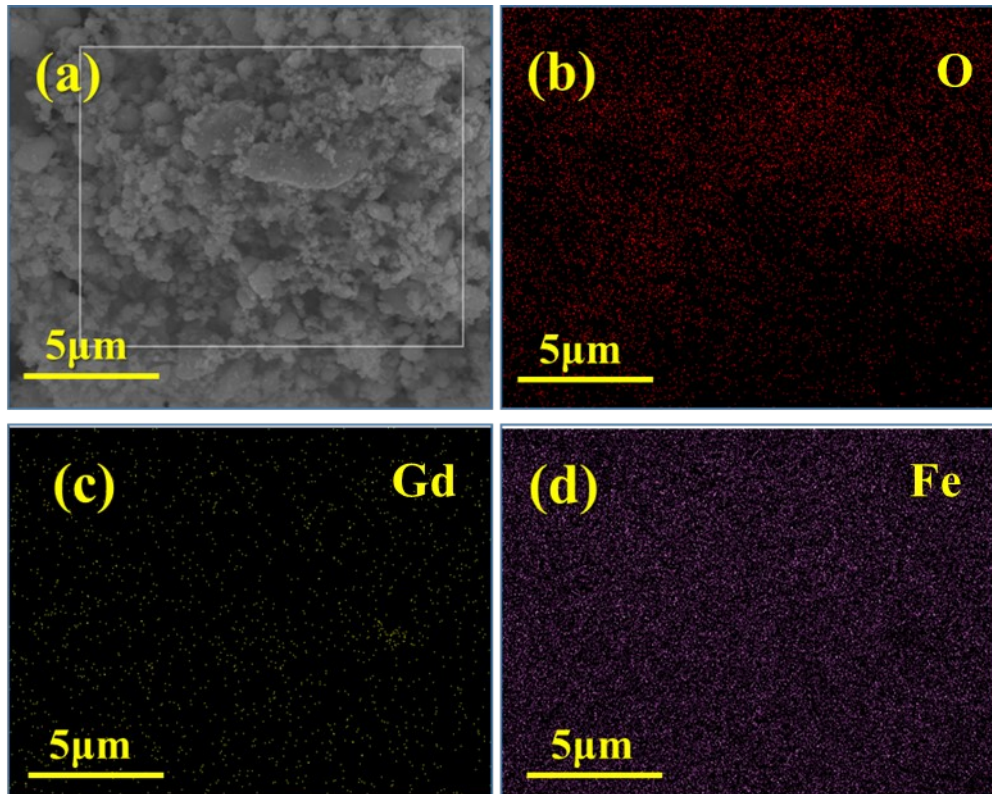
S2: FTIR of 2.5% hematite doped PVDF membrane



S3: Zeta Potential of natural α -hematite



S4: FESEM of Gd incorporated α -hematite (a) and mapping (b-d) of PVGF2.5 membrane suggesting the homogeneous distribution of doped Gd incorporated in α -hematite



S5: Formulation of force calculation:

The velocity has been calculated from the relation of conservation of energy,

$$mgh = \frac{1}{2} mv^2 \dots \dots \dots (1)$$

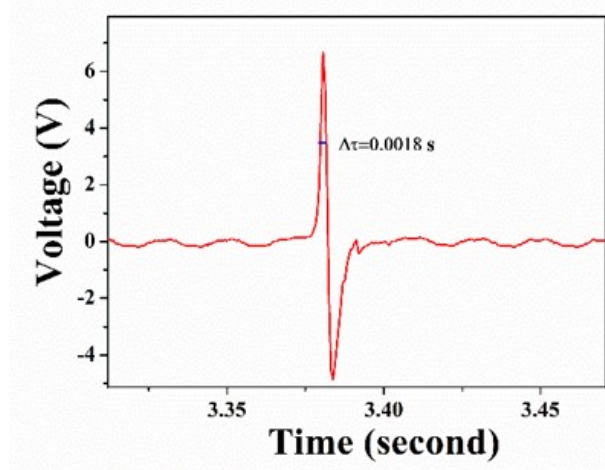
where m is the mass, g is the gravitational constant, h is the height from where the mass departed on the membrane, and v is the velocity.

Secondly,

$$mv = (F-mg) \Delta t \dots \dots \dots (2)$$

$$F = m (v/\Delta t + g) \dots \dots \dots (3)$$

Initially, applying the mass 0.016 kg, h 0.1 m, and Δt is the impulsive time calculated from the open circuit voltage graph (FWHM) and found $\Delta t = 0.0018$ s.



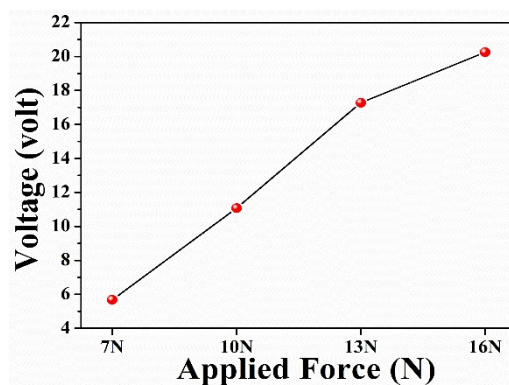
From equation 3 we have calculated the force and found 13.49 N.

The force has been varied by applying different masses.

S6: Formulation of force calculation:

Sample Type	d ₃₃	d ₃₃	d ₃₃	d ₃₃	d ₃₃	Avg.	Std. Deviation
PVGF0	4.15	4.74	4.92	5.12	4.81	4.748	0.363827
PVGF2.5	49.7	47.44	45.8	48.29	45.39	47.324	1.778688
PVGF5	25.07	27.83	28.52	26.54	27.29	27.05	1.323575

S7: Force-dependent voltage generation for PVGF2.5



S8: Water flow-mediated energy generation and detail setup



PVGF2.5_Energy generation.mp4