

Supplementary Information

**Chemical Reactions under the Nanofluidic Confinement of Reconstructed
Lamellar Membrane**

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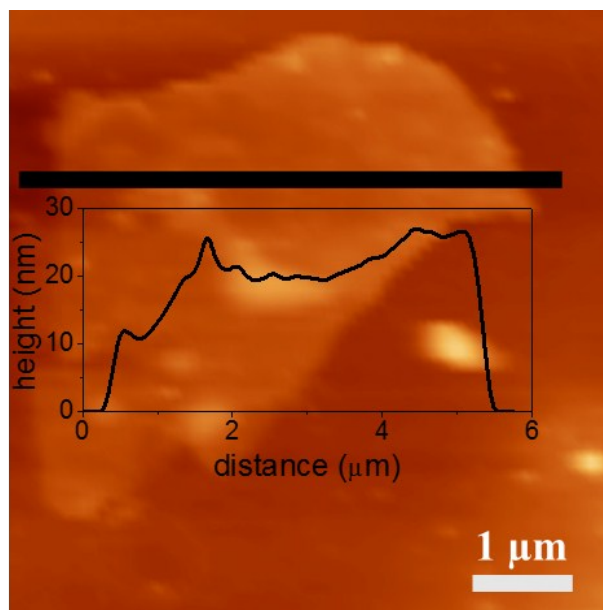


Figure S1. AFM image of exfoliated vermiculite nanoflakes along with a corresponding height profile.

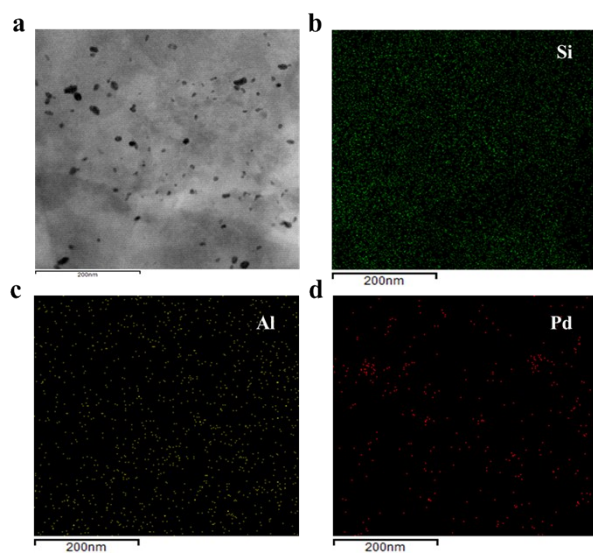


Figure S2. TEM-EDX elemental mapping of a Pd-VM-NF, for (b) silicon, (c) aluminium, and (d) palladium atoms.

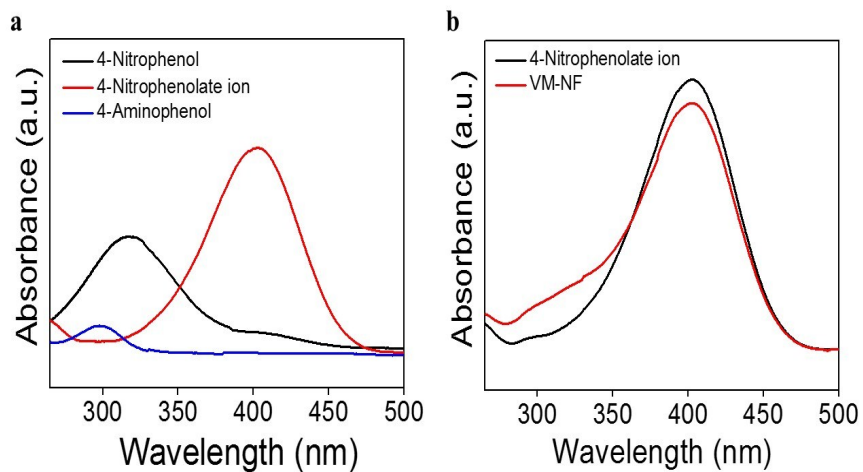


Figure S3. UV-Vis spectra showing reduction of 4-NP to 4-AP using (a) Pd-VM-NF, and (b) vermiculite nanoflakes as catalyst in presence of 1 M NaBH₄ (30 μ L) for 0.1 mM 4-NP (2 mL).

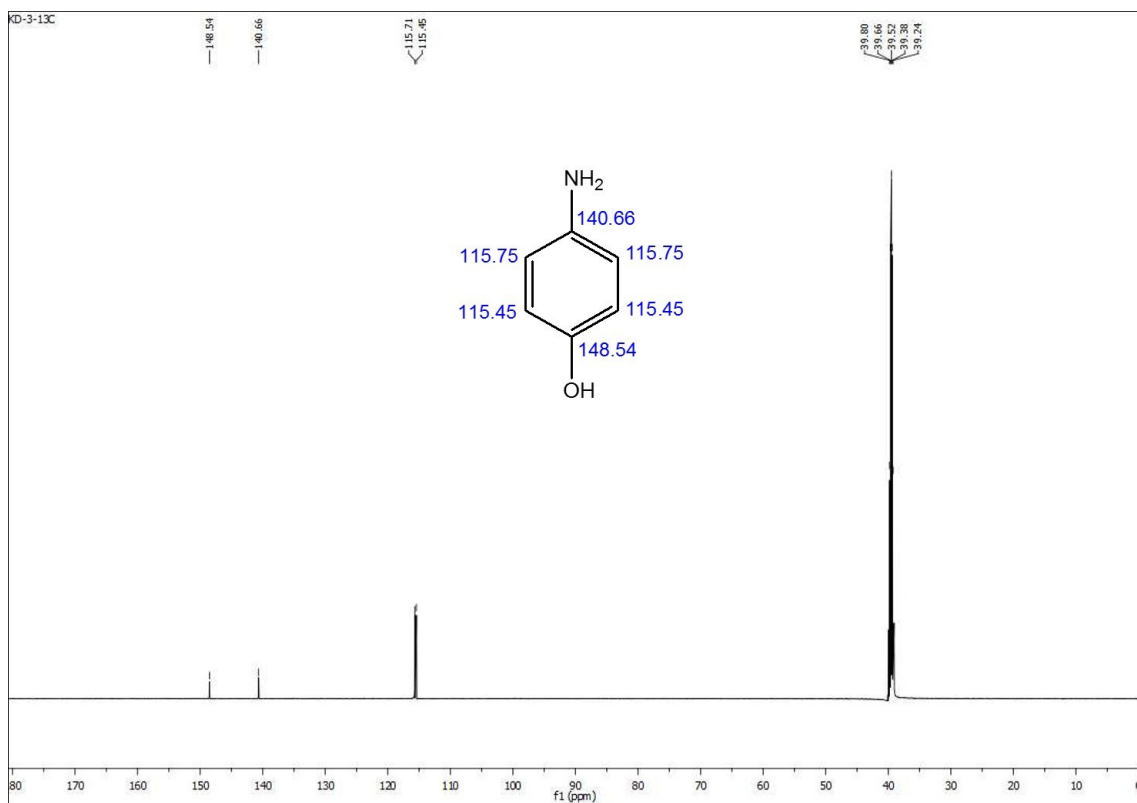


Figure S4. ¹³C NMR spectra of the product (4-NP) obtained from the reaction inside the catalytic nanochannels of Pd-VM membrane.

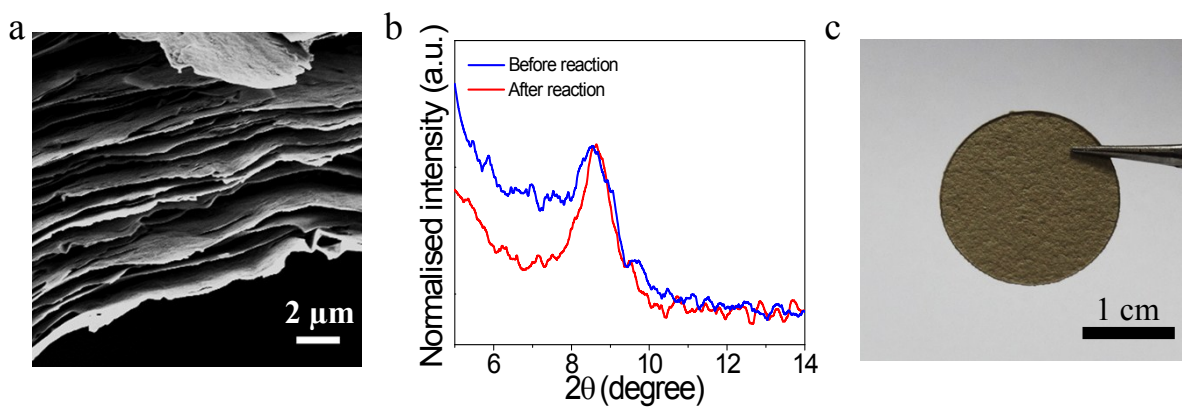


Figure S5. Stability of the catalytic Pd-VM membrane: (a) Cross-sectional FESEM image, (b) pXRD pattern and (c) optical image of Pd-VM membrane after completion of the catalytic reaction.

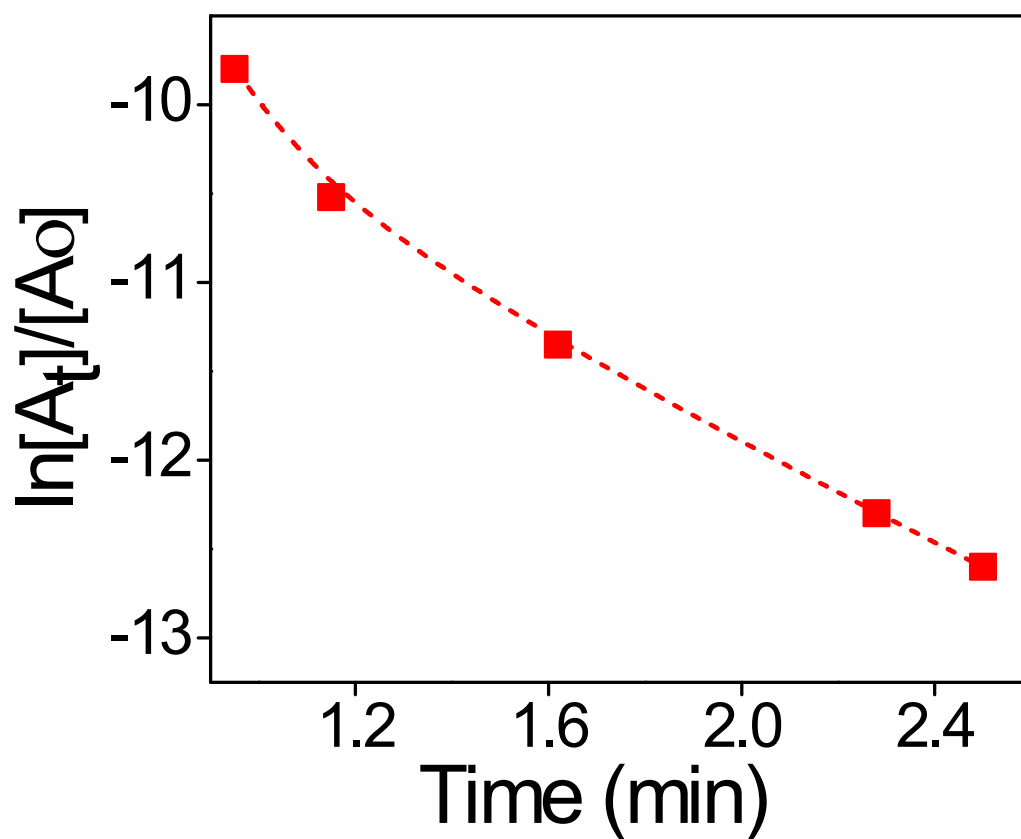


Figure S6. Concentration vs time graph for phenolate intermediate. The reaction was performed in Pd-VM membrane of five different thicknesses ranging from 00.4 to 0.32 mm using 0.1 mM 4-NP (2 mL) and 0.05 M NaBH₄ (30 μ L).

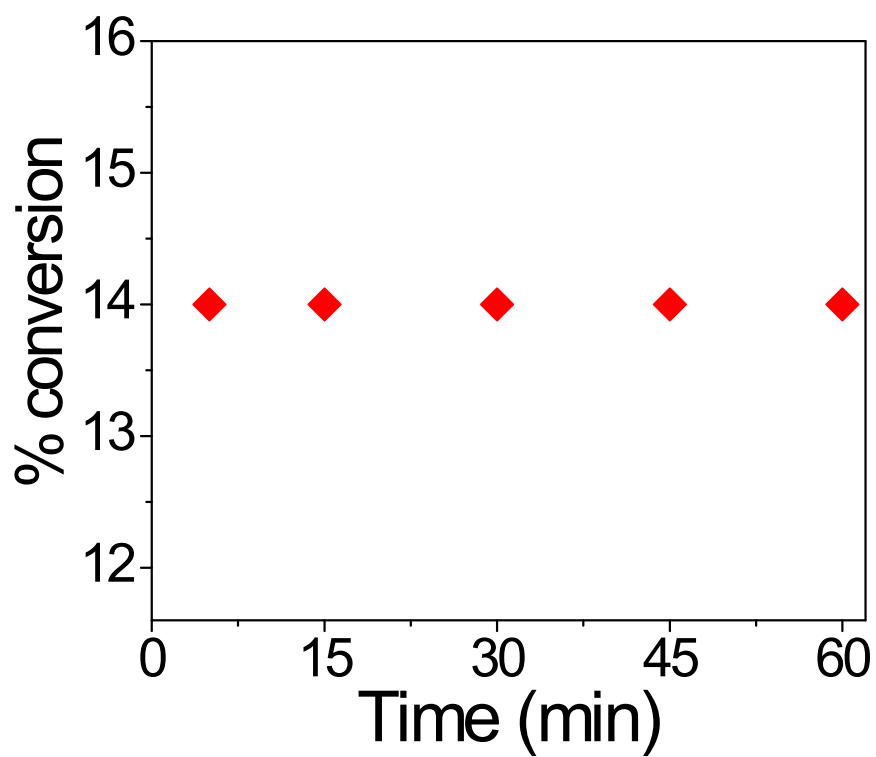


Figure S7. Progress of the reduction reaction of 4-NP to 4-AP with Pd-VM-NF in bulk stirring condition, concentration of NaBH_4 was kept as 0.05 M.

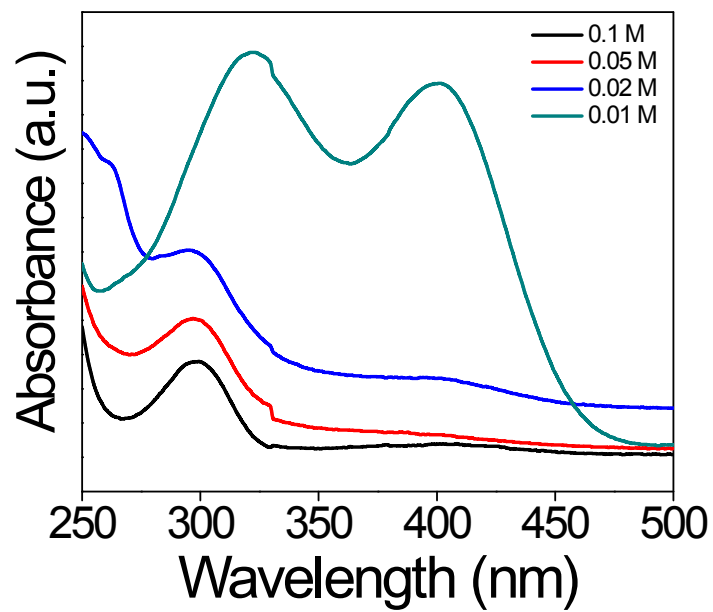


Figure S8. UV-Vis spectra of the products obtained from the reaction of 4-NP with different concentrations of NaBH₄ (from 0.1 M to 0.01 M), inside the catalytic nanochannels of Pd-VM membrane.

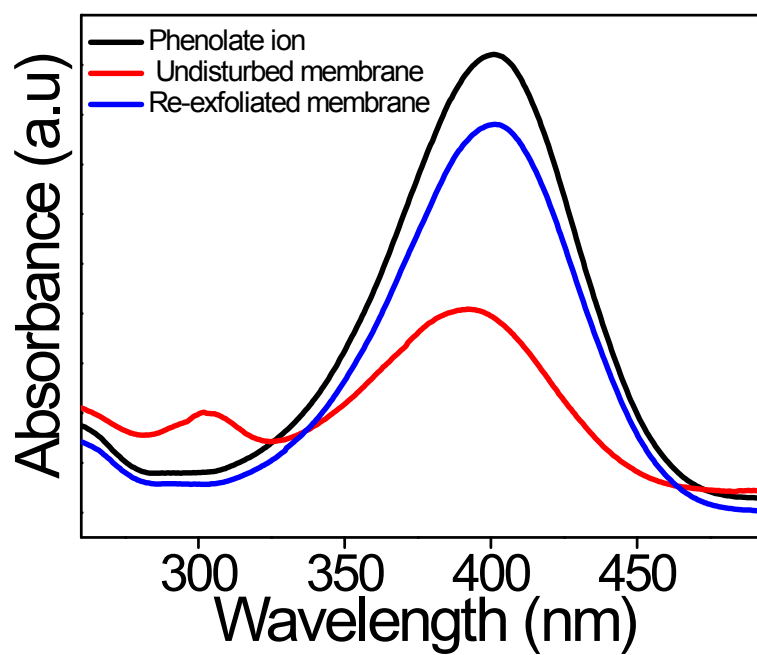


Figure S9. UV-Vis spectra of the reaction mixtures comparing conversion of 4-NP to 4-AP through Pd-VM membrane pre-treated with (0.1 M) NaBH_4 . While the red curve represent reaction through undisturbed membrane, the blue curve represent reaction with the re-exfoliated flakes of pre-treated membrane.

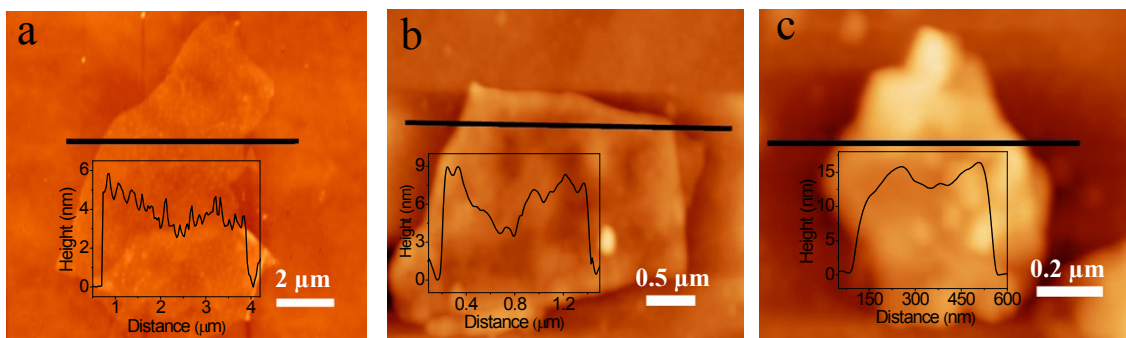


Figure S10. AMF images of vermiculite nanoflakes of different size fractions obtained *via* centrifugation at (a) 700 rpm, (b) 1000 rpm and (c) 2000 rpm. The corresponding height profiles are given as the inset.

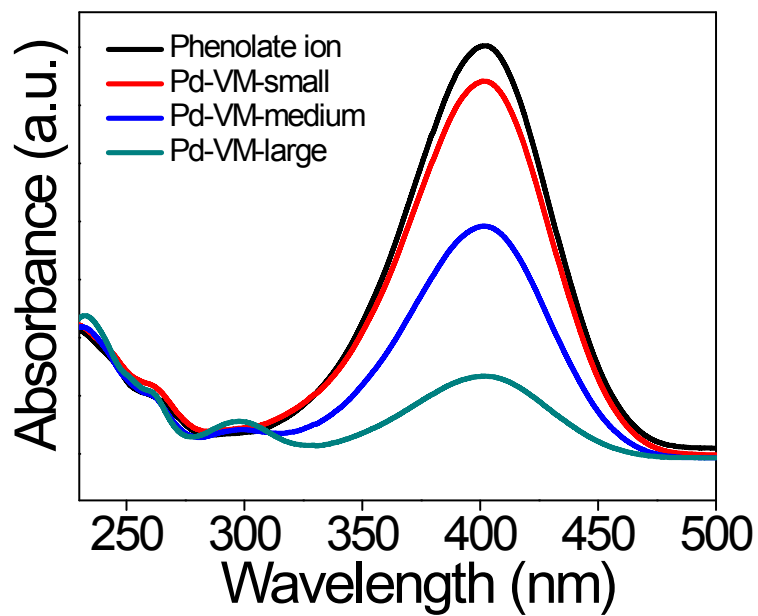


Figure S11. Effect of nanoflakes dimension on the reduction reaction: UV-Vis spectra showing conversion 4-NP to 4-AP through membranes fabricated using Pd-VM-NF of different dimensions of flakes.

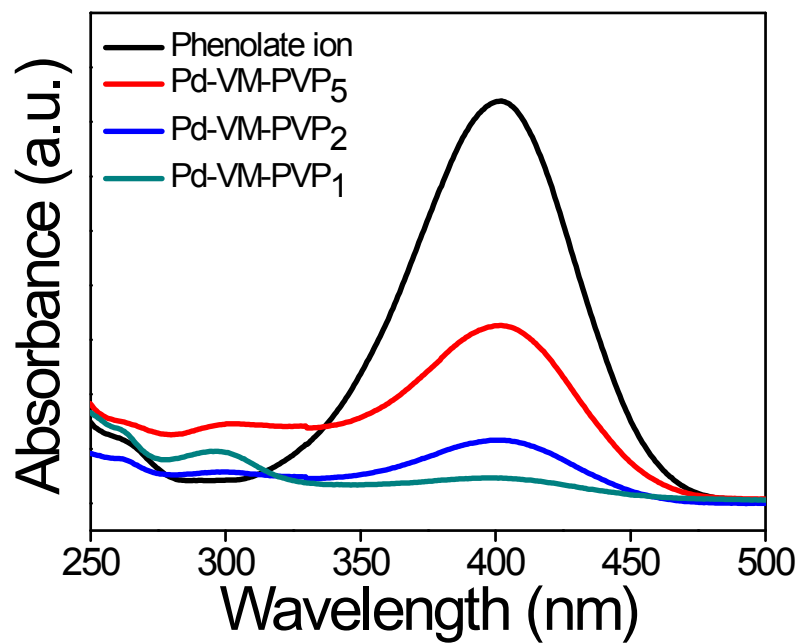


Figure S12. UV-Vis spectra showing conversion of 4-NP to 4-AP through Pd-VM-NF membrane with altered channel heights using different ratio of PVP polymer as spacers.

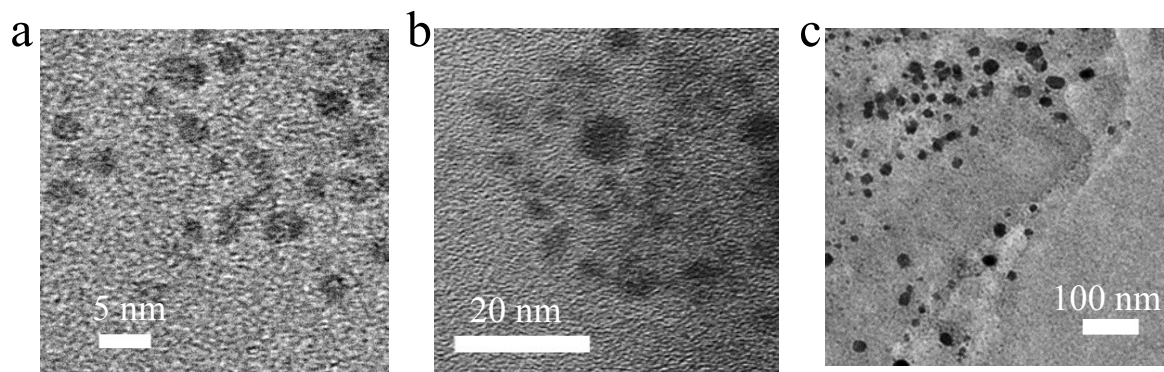


Figure S13. TEM image of Pd-VM-NF obtained by stirring VM-NF with (a) 0.005 M, (b) 0.01 M and (c) 0.1 M of Pd²⁺ solution.

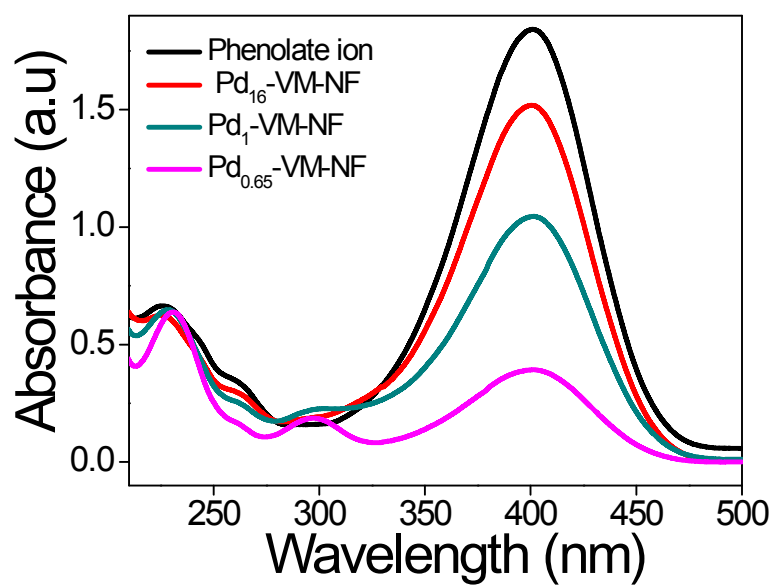


Figure S14. UV-Vis spectra showing conversion of 4-NP to 4-AP through Pd-VM membrane loaded with different percentage of palladium.

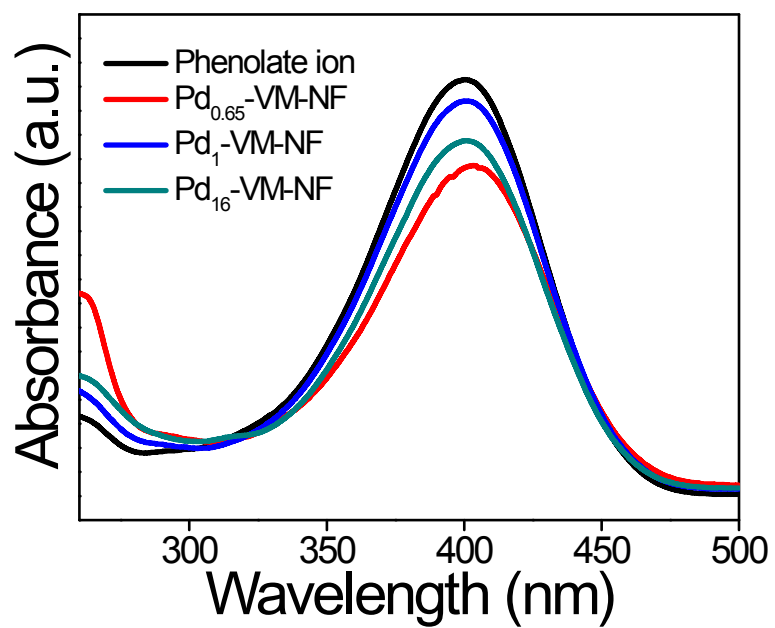


Figure S15. UV-Vis spectra showing conversion of 4-NP to 4-AP in Pd-VM membrane loaded with Pd nanoparticles of different sizes, in presence of 0.01 M NaBH₄.

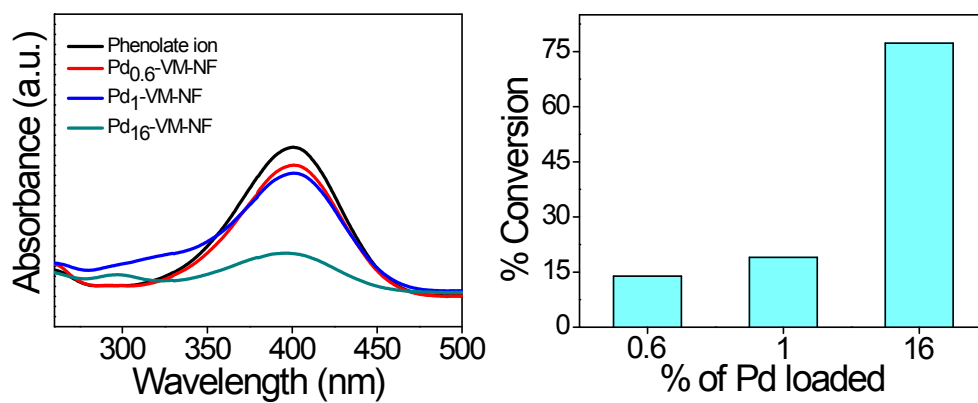


Figure S16. Catalytic activity of Pd-VM-NF with different palladium content towards reduction of 4-NP to 4-AP under bulk (stirring) condition.

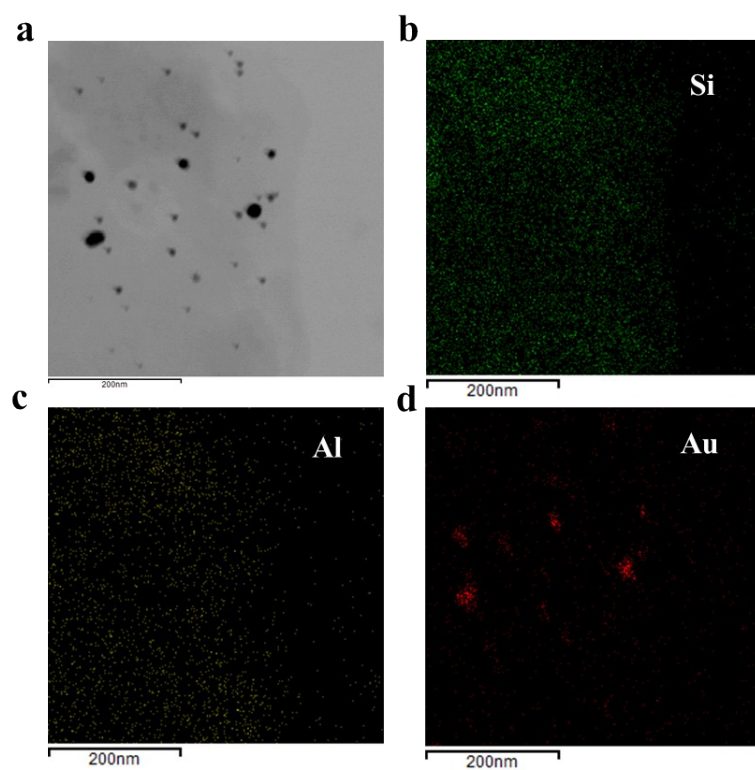


Figure S17. TEM-EDX elemental mapping of Au-VM-NF: (b) silicon, (c) aluminium, and (d) gold atoms.

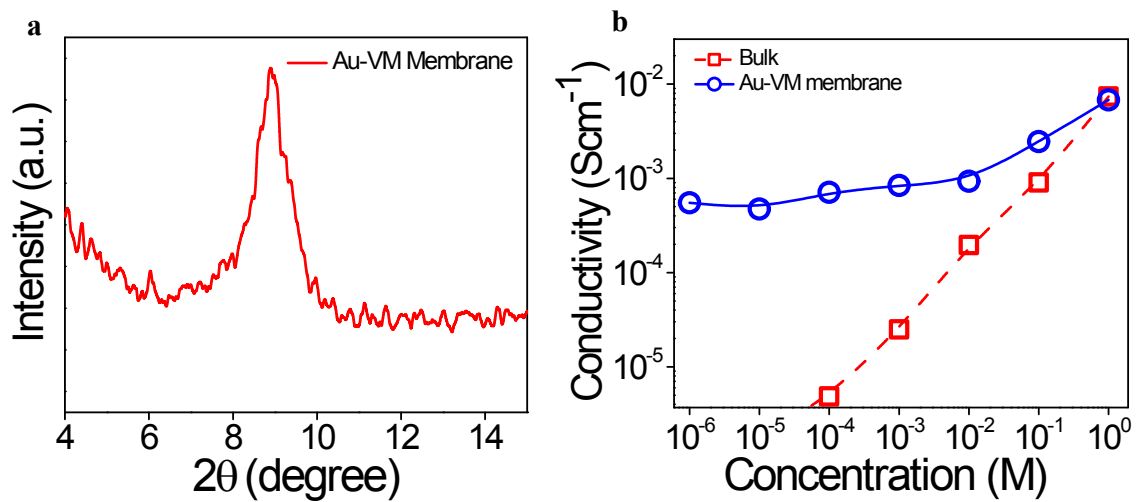


Figure S18. (a) Powder XRD pattern, and (b) Surface charge governed ionic transport behaviour of the Au-VM-NF membrane.

