

SUPPORTING INFORMATION

WSe₂ nanoparticles with enhanced hydrogen evolution reaction prepared by bipolar-electrochemistry: application in competitive magneto-immunoassay

Vlastimil Mazánek,^a Carmen C. Mayorga-Martinez,^a Daniel Bouša,^a Zdeněk Sofer,^a Martin Pumera^{a*}

^a Center for Advanced Functional Nanorobots, Department of Inorganic Chemistry, Faculty of Chemical Technology, University of Chemistry and Technology Prague, Technická 5, 166 28 Prague 6, Czech Republic

*E-mail: pumera.research@gmail.com

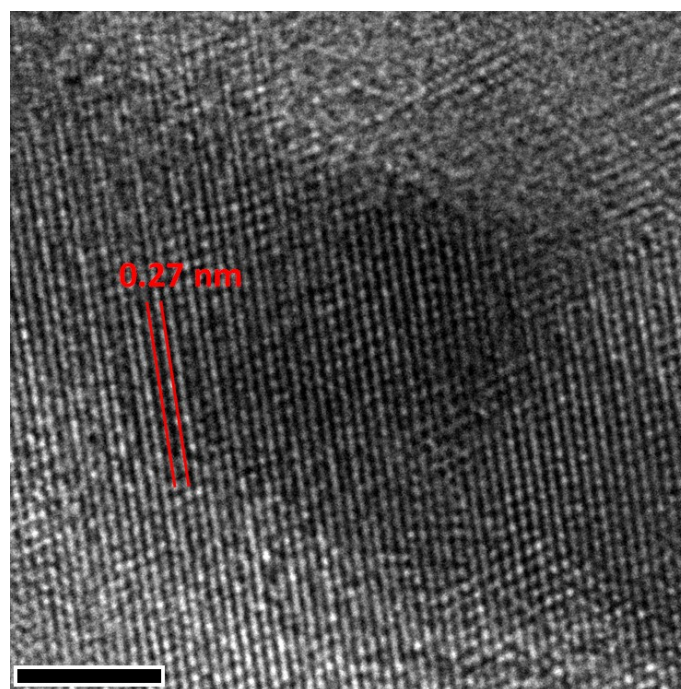


Figure S1. Detail from HR-TEM image with atomic fringes and corresponding spacing (0.27 nm). The scale bar is 3 nm.

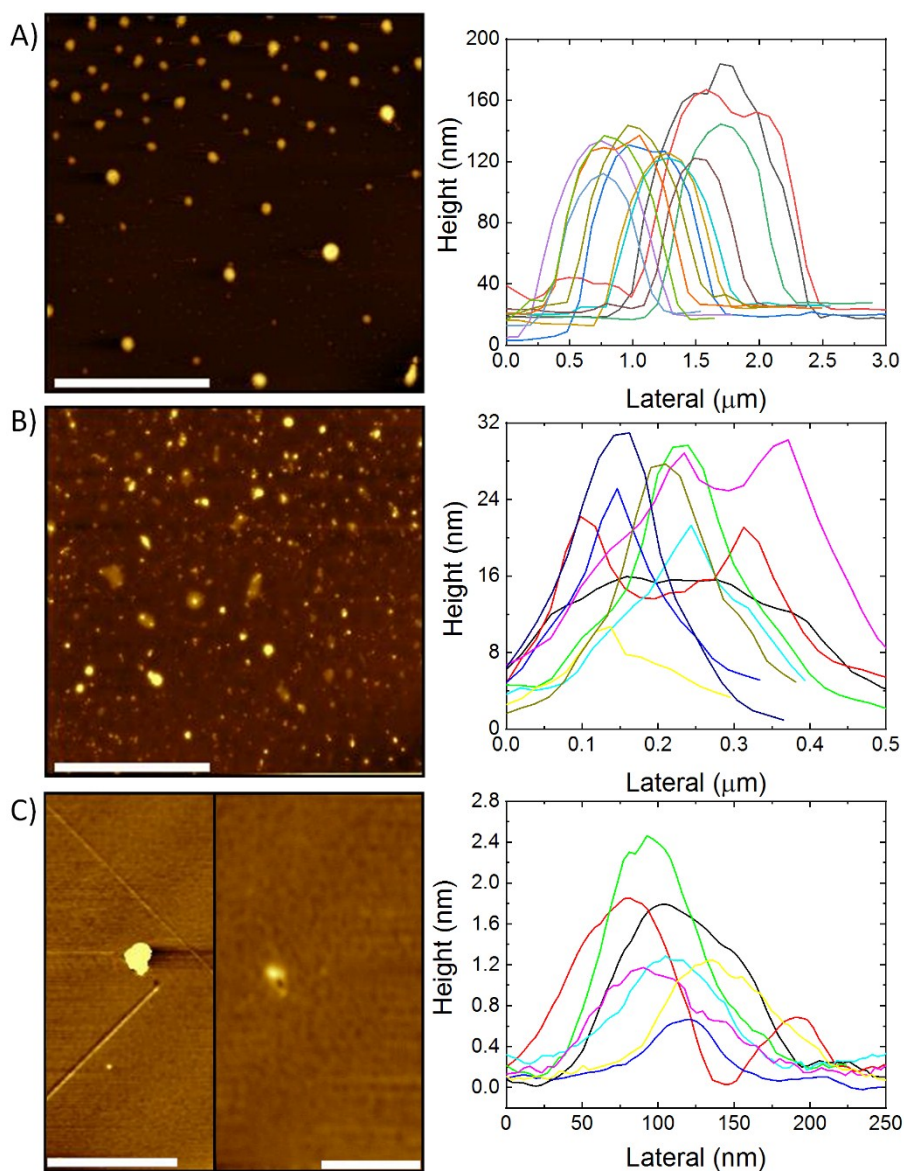


Figure S2. Pictures obtained by AFM and corresponding height profiles of A) WSe_2 t-buli, B) WSe_2 BE and C) WSe_2 NPs with scale bars 10, 10 μm and 500 nm, respectively. C) A five-layer nanoparticle is shown in left-handed image, while single-layer particle is in the right-handed image. Moreover, shown profiles were taken from more nanoparticles.

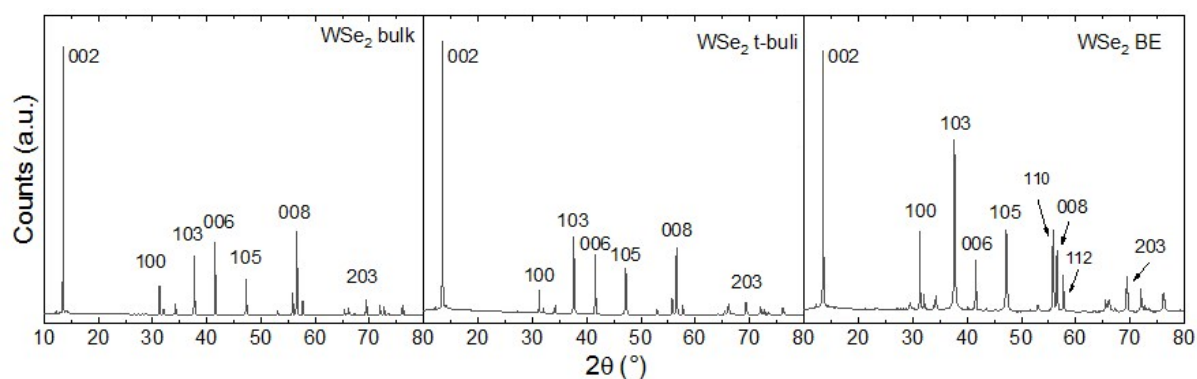


Figure S3. XRD patterns of WSe_2 samples in which the most intense reflections were labelled.

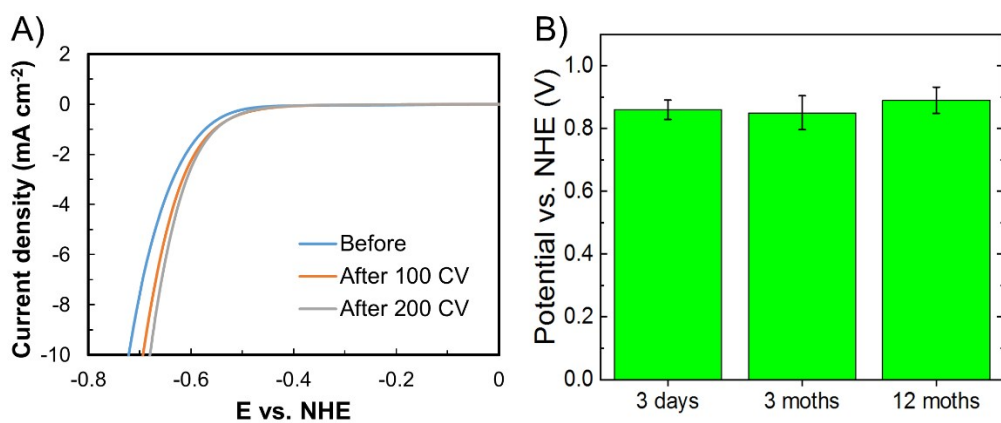
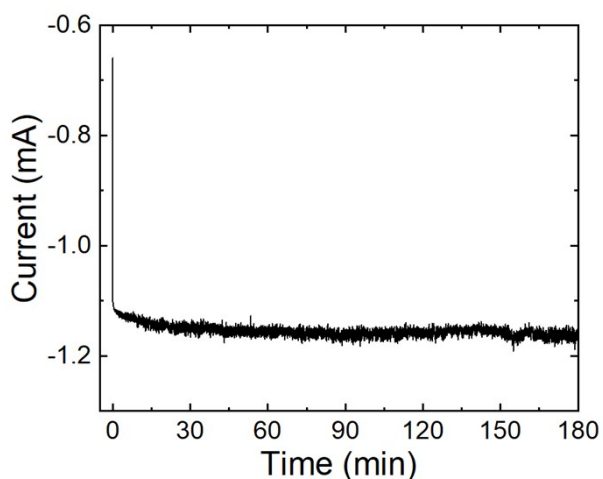


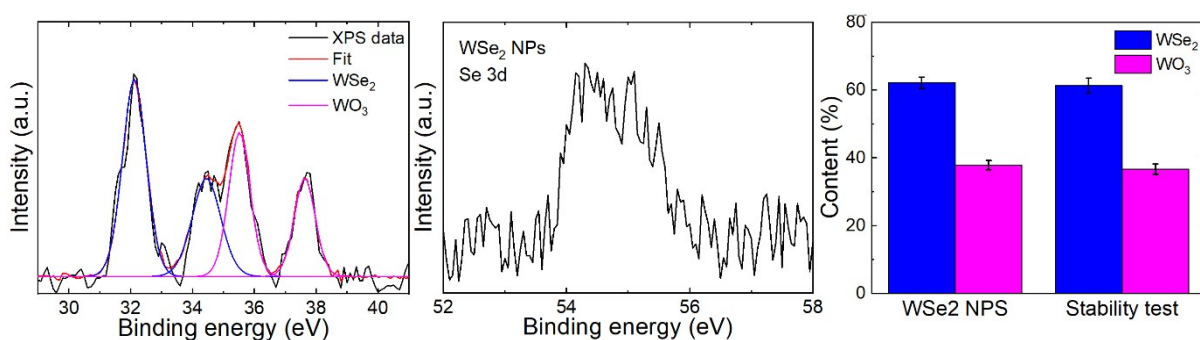
Figure S4. Electrochemical stability tests: A) HER polarisation curves of WSe₂ before and after 100 and 200 cyclic voltammetry cycles in sulfuric acid (0.5 M), and B) HER onsetpotentials at -10 mAcm⁻²from



WSe₂ NPs after 3 days, 3 months and 12 months. The error bars are based on three measurements.

Figure S5. Electrochemical stability of WSe₂ NPs conducted by chronoamperometry using -1.2 V.

Figure S6. HR-XPS spectra obtained after the chronoamperometric test of stability. Bar chart is a comparison of the content of WSe₂ and WO₃ in WSe₂ NPS before and after the test of stability. The error bars are based on two measurements.



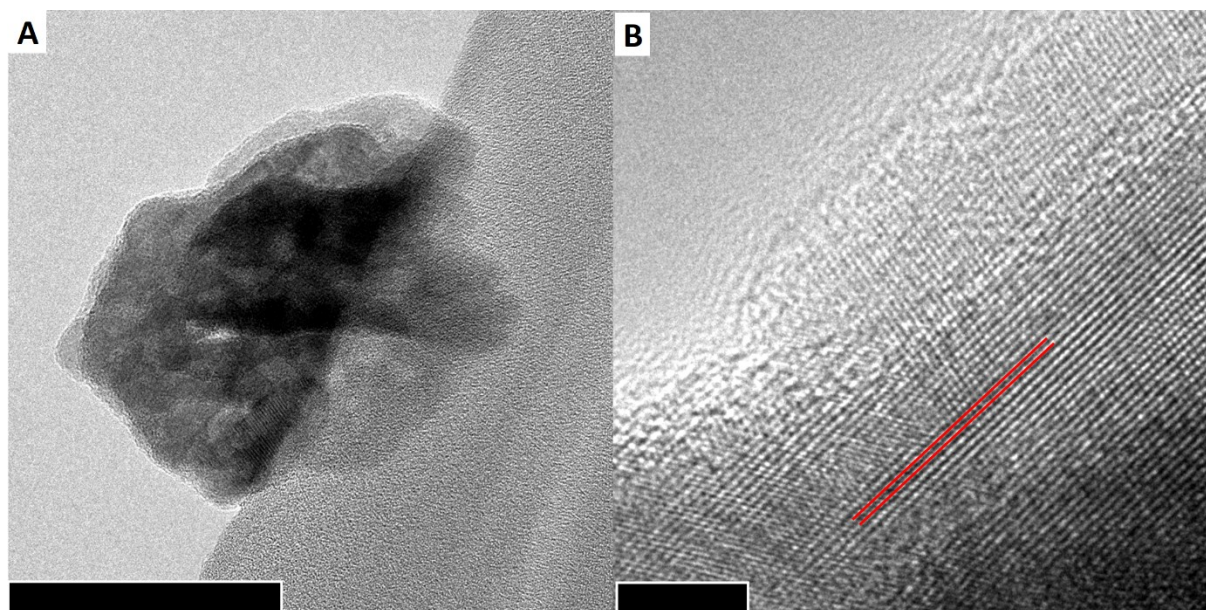
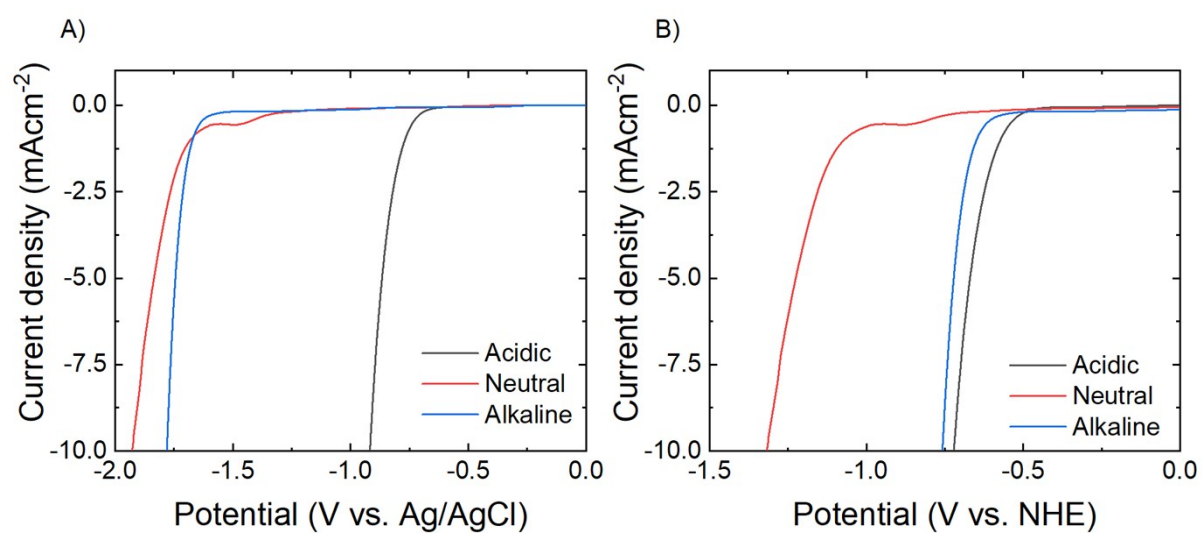


Figure S7. A) The TEM image of WSe_2 NPs after the chronoamperometric test of stability. B) Detail from HR-TEM image with atomic fringes with corresponding spacing (0.27 nm). The scale bar is A) 70 nm



and B) 5 nm.

Figure S8. A) As measured LSV of HER conducted in acidic, neutral and alkaline electrolytes. B) The potential was recalculated vs normal hydrogen electrode.

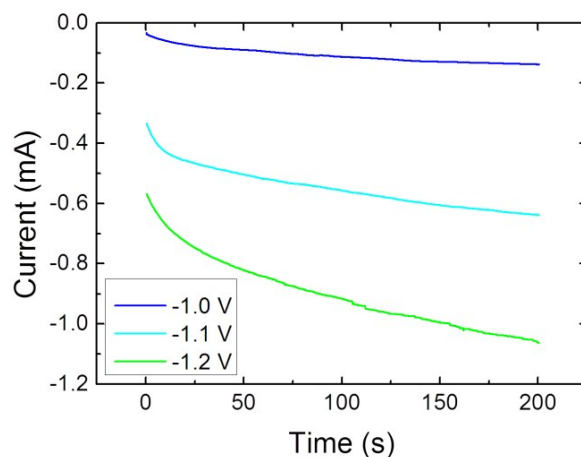


Figure S9. Chronoamperograms of WSe₂ NPs on SP electrode measured with three different applied potentials.

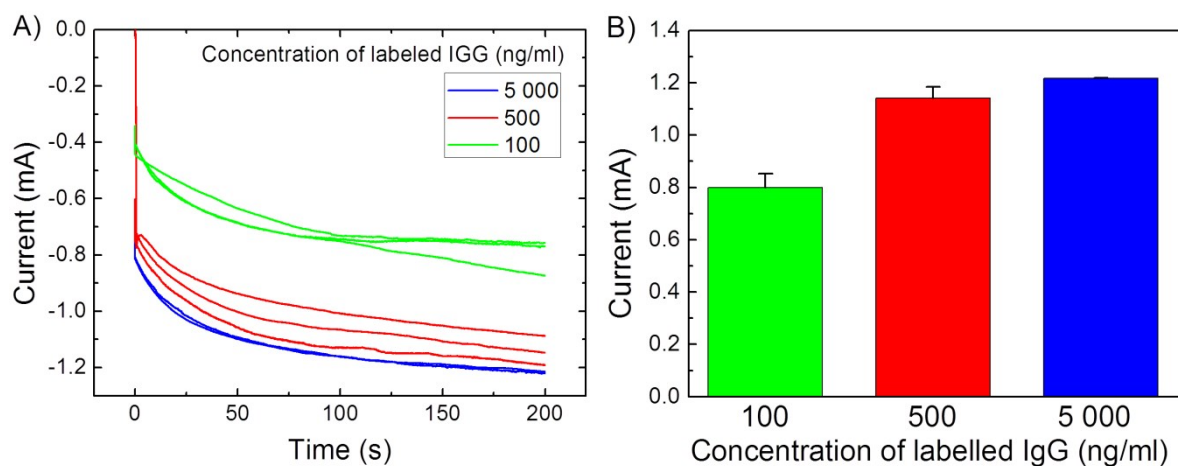


Figure S10. A) Chronoamperometry responses of protein detection in competitive magneto immunoassay configuration under different concentration of rabbit IgG labelled with WSe₂ NPs (legend) with 500 ng/ml of label-free IgG. B) Current response after 200 s with error bars based on three measurements.