Supporting Information

Nickel tungstate nanoparticles synthesized via surfactant-assisted method: an efficient platform for neurotransmitter detection

Werayut Srituravanich[a,b,c], Balasubramanian Akila[d], Tse-Wei Chen[e,*], Shen-Ming Chen[d,*], Umesh Narasimha Murthy[a,b,c], Elayappan Tamilalagan[d], Bih-Show Lou[f,g*], Sakthivel Kogularasu[h,i], Guo-Ping Chang-Chien[h,i,j]

[a]Micro/Nano Electromechanical Integrated Device Research Unit, Department of Mechanical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok, 10330, Thailand

[b]Biomedical Engineering Program, Faculty of Engineering, Chulalongkorn University, Bangkok, 10330, Thailand

[c]Biomedical Engineering Research Center, Faculty of Engineering, Chulalongkorn University, Bangkok, 10330, Thailand

[d]Department of Chemical Engineering and Biotechnology, National Taipei University of Technology, No. 1, Section 3, Chung-Hsiao East Road, Taipei 106, Taiwan.

[e]Department of Marine Environmental Engineering, National Kaohsiung University of Sci-ence and Technology, Kaohsiung City 81157, Taiwan.

[f]Chemistry Division, Center for General Education, Chang Gung University, Taoyuan 333, Taiwan.

[g]Department of Nuclear Medicine and Molecular Imaging Center, Chang Gung Memorial Hospital, Taoyuan 333, Taiwan.

[h]Super Micro Mass Research and Technology Center, Cheng Shiu University, Kaohsiung 833301, Taiwan.

[i]Center for Environmental Toxin and Emerging-Contaminant Research, Cheng Shiu University, Kaohsiung 833301, Taiwan.

[j]Institute of Environmental Toxin and Emerging-Contaminant, Cheng Shiu University, Kaohsiung 833301, Taiwan.

[*]Corresponding authors – twchenchem@gmail.com (T.-W. Chen); smchen78@ms15.hinet.net (S.-M. Chen) ; blou@mail.cgu.edu.tw (B.-S. Lou)

Materials and Methods: Nickel nitrate hexahydrate ($Ni(NO_3)_2 \cdot 6H_2O$), sodium tungstate dihydrate ($Na_2WO_4 \cdot 2H_2O$), cetyltrimethylammonium bromide, Dopamine, sodium hydroxide (NaOH), potassium chloride (KCl), sodium phosphate dibasic (Na_2HPO_4; ≥99.0%), sodium dihydrogen phosphate (NaH_2PO_4), all of which were procured from Sigma-Aldrich, Nice Chemicals Pvt. Ltd., Alfa Aesar, and Showa Chemical Industry Co., Ltd., and used without further purification. Ultrapure water (specific resistivity > 18 MΩ·cm) obtained from a Milli-Q water purification system (Millipore, Molsheim, France) was employed in all experiments to ensure high purity standards. A 0.1 M phosphate buffer (PB) solution at pH 7, prepared using Na_2HPO_4 and NaH_2PO_4, was utilized as the supporting electrolyte across all electrochemical analyses.

Materials Characterizations*:* Phase configuration is identified using Bruker D2 advance instrument X-ray diffractometer though CuKα radiation (λ = 1.5405Å). Perkin Elmer spectrometer is employed to record Fourier transform infrared spectra in the range of 400-4000 cm^{-1}. The surface morphology and the elemental composition of the synthesized samples are studied utilizing high resolution (HR) transmission electron microscopy (H-7600, Hitachi-Japan) and energy dispersive X-ray spectroscopy operating at 200 kV. The electrochemical properties are explored using electrochemical impedance spectroscopy (EIS) through Autolab (PGSTAT204). CHI 1211c electrocatalytic workstation is functional to carry out the electrochemical measurements like cyclic voltammetry (CV) and Amperometric (i-t) in a conventional three electrode cell. Here, the GCE (diameter=3 mm and geometrical surface area = 0.071 cm^2), saturated Ag|AgCl and Pt wire are active as working, reference and counter electrodes, respectively.

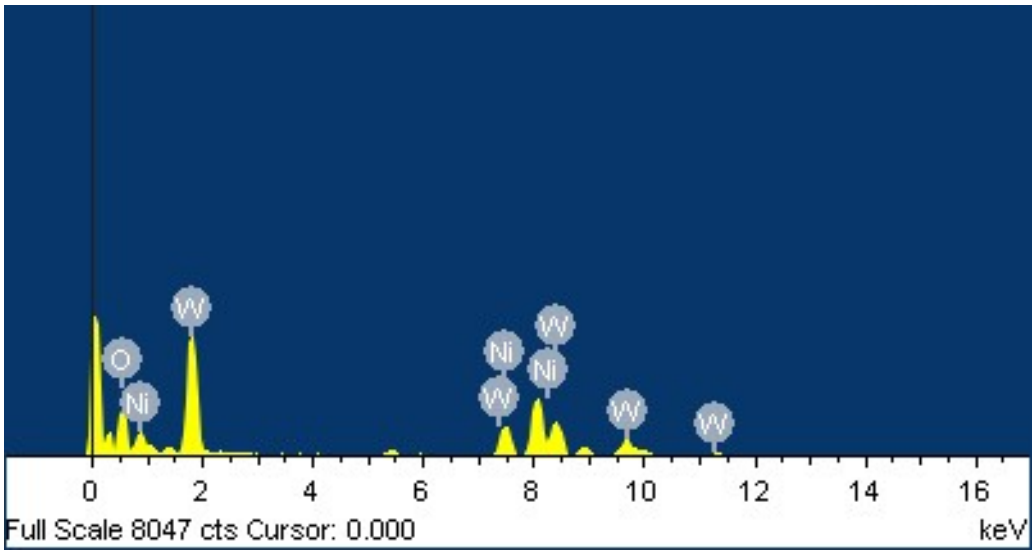

Figure S1. EDX spectrum of $NiWO_4$ UNPs.

Table S1. The wavenumber, vibrational mode structural assignment, remarks and bonding characteristics of the synthesized $NiWO_4$.

Wavenumber (cm^{-1})	**Vibrational Mode**	**Structural Assignment**	**Remarks**
548	Ni–O stretching	NiO_6 octahedra	Confirms Ni-centered octahedra
869, 820	W–O stretching	WO_6 octahedra	Internal stretching of tungstate groups
710, 639	O–W–O asymmetric stretching & bending	Distorted WO_6 octahedra	Formation of wolframite-type network