

Chalcogenide vacancies drive the electrocatalytic performance of rhenium dichalcogenides

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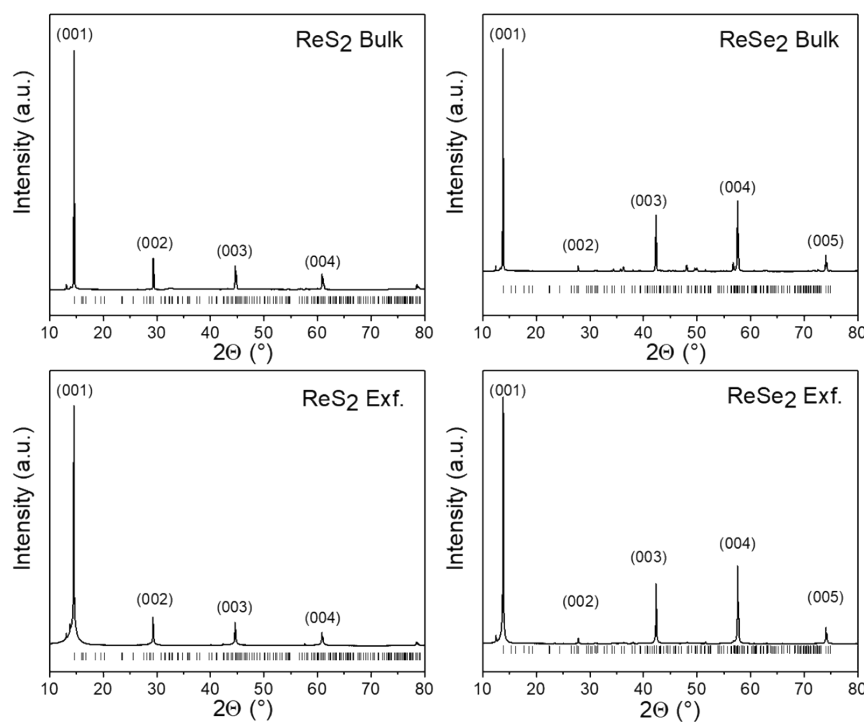


Figure S1. X-ray diffractograms of bulk and exfoliated Re chalcogenides.

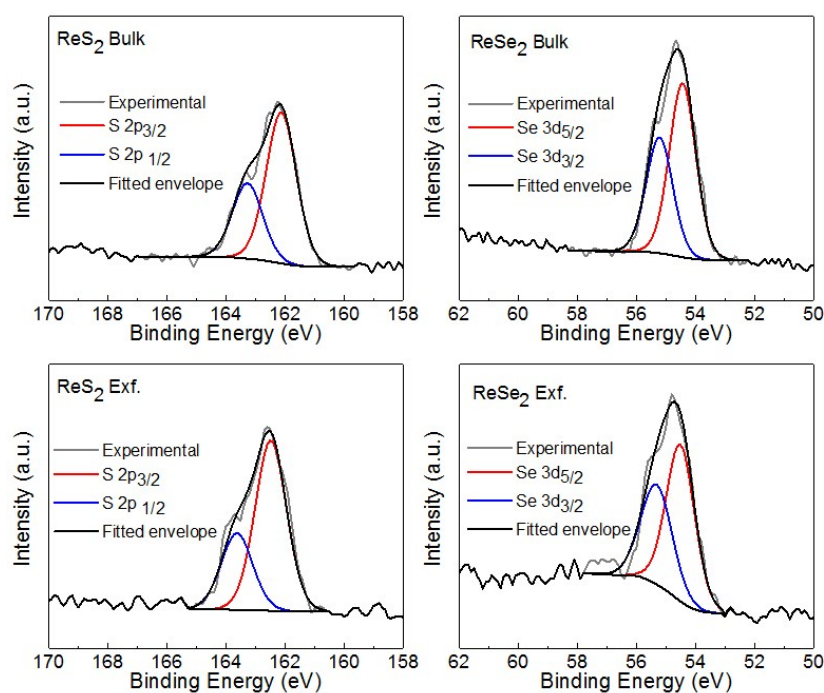


Figure S2. Core-level XP spectra of S 2p and Se 3d regions of bulk (top) and exfoliated (bottom) Re chalcogenides.

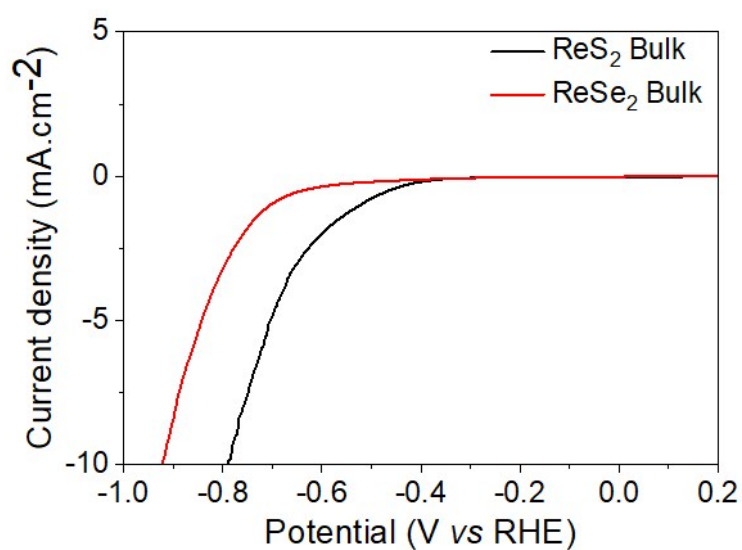


Figure S3. LSV curves of bulk ReS_2 and ReSe_2 . 0.5M H_2SO_4 , scan rate 2mV/s.

Table S1. Comparison of the performance of the catalysts reported here and in the literature.

Reference	Material	Overpotential @10mA.cm ⁻² (V)	Preparation method
This work	ReS ₂	0.36	Electrochemical treatment
1	ReS ₂	0.34	Deposition on a 3D GC foam
2	ReSe _{1.78} S _{0.22} on carbon fiber paper	0.12	Solvothermal
3	ReS ₂	>>0.35	Hydrothermal method
This Work	ReSe ₂	0.43	Electrochemical treatment
4	ReSe ₂	0.24	Chemical vapor deposition
3	ReSe ₂	0.32	Hydrothermal method

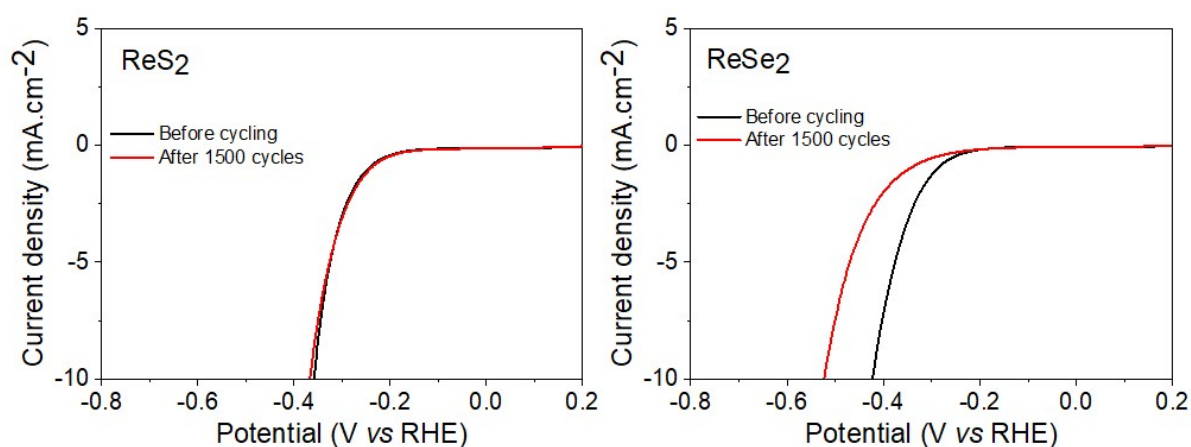


Figure S4. The performance of Rhenium chalcogenides catalysts before and after cycling in 0.5M H₂SO₄.

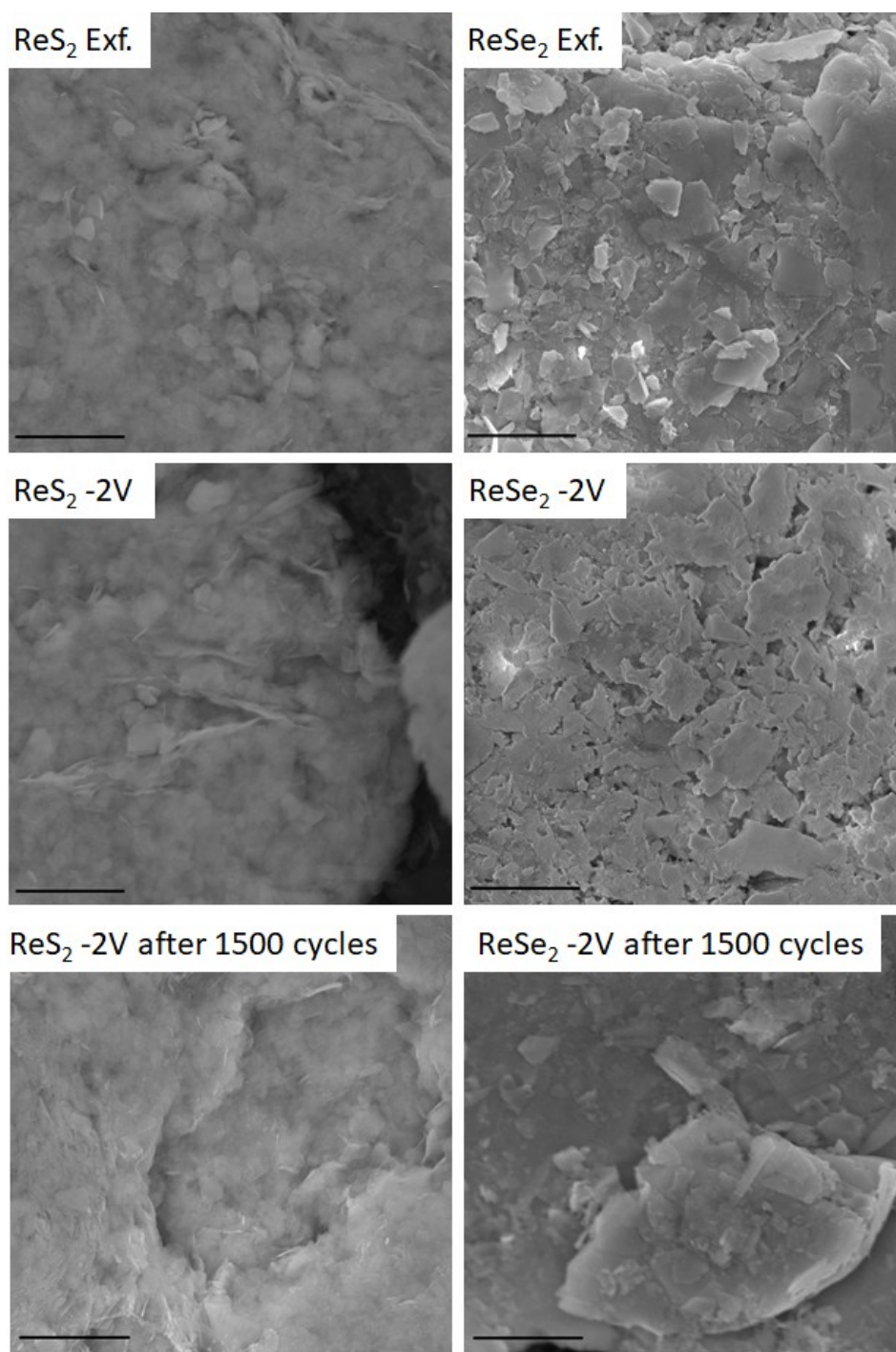


Figure S5. SEM images of Re chalcogenides drop casted on top of GC electrode. Samples untreated with electrochemical potential, samples treated with -2 V potential in H₂SO₄ and samples treated with -2 V potential in H₂SO₄ after 1500 cycles are compared here. Scale bars correspond to 1 μm.

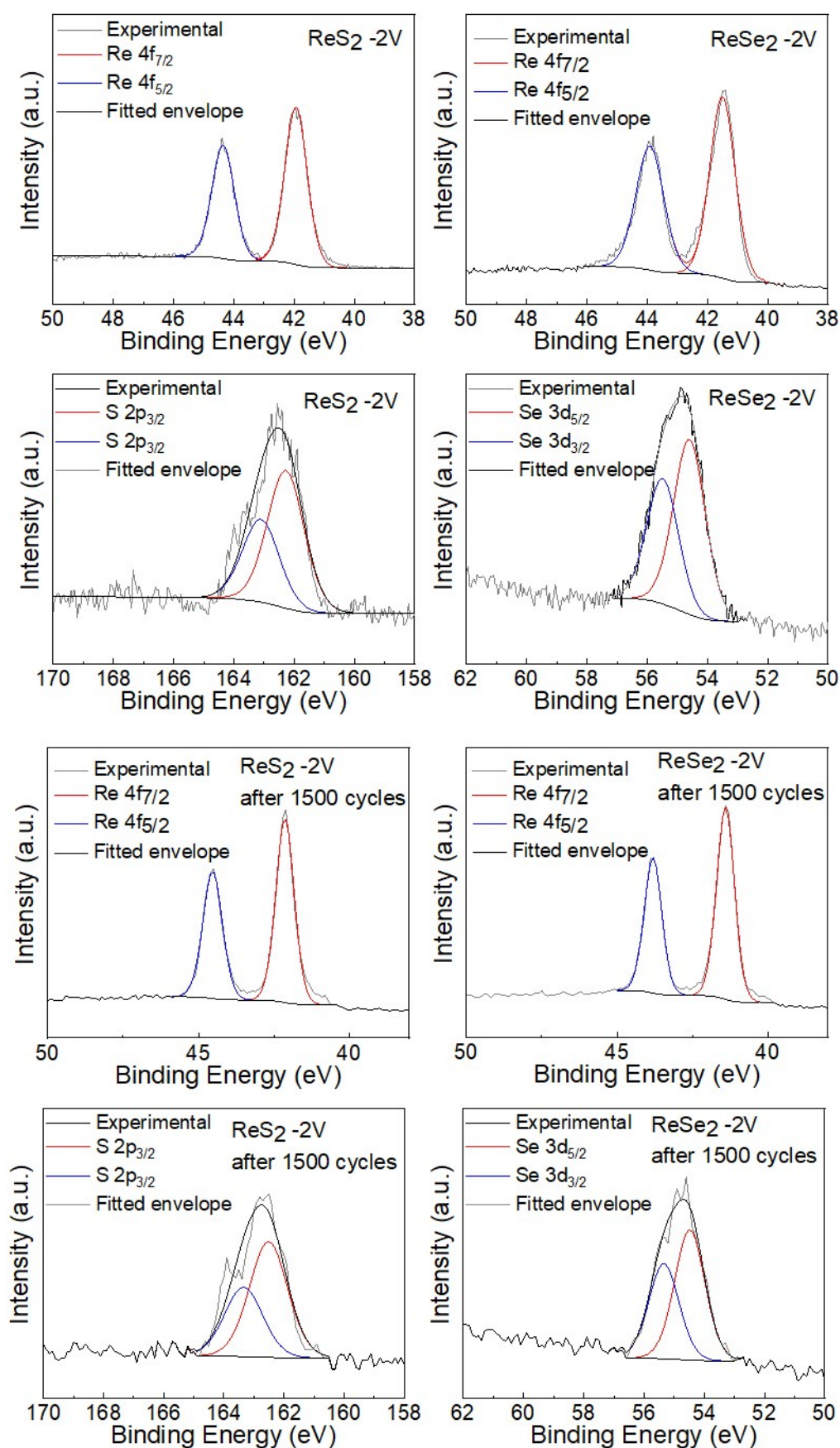


Figure S6. Core-level XPS spectra of Re 4f, S 2p and Se 3d regions after treatment with -2V potential and after 1500 cycles.

1. L. Wang, Z. Sofer, J. Luxa, D. Sedmidubský, A. Ambrosi and M. Pumera, *Electrochemistry Communications*, 2016, **63**, 39-43.
2. Y. Xia, J. Huang, W. Wu, Y. Zhang, H. Wang, J. Zhu, J. Yao, L. Xu, Y. Sun, L. Zhang, R. Lu, J. Xiong and G. Zou, *ChemCatChem*, 2018, **10**, 4424-4430.
3. F. Qi, X. Wang, B. Zheng, Y. Chen, B. Yu, J. Zhou, J. He, P. Li, W. Zhang and Y. Li, *Electrochimica Acta*, 2017, **224**, 593-599.
4. S. Jiang, Z. Zhang, N. Zhang, Y. Huan, Y. Gong, M. Sun, J. Shi, C. Xie, P. Yang, Q. Fang, H. Li, L. Tong, D. Xie, L. Gu, P. Liu and Y. Zhang, *Nano Research*, 2018, **11**, 1787-1797.