Nanoscale

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ARTICLE

Origin of exotic ferromagnetic behavior in exfoliated layered transition metal dichalcogenides MoS_2 and WS_2

Cite this: DOI: 10.1039/xoxxoooooox

Received ooth January 2012,
Accepted ooth January 2012

DOI: 10.1039/xoxxoooooox

www.rsc.org/

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SUPPORTING INFORMATION

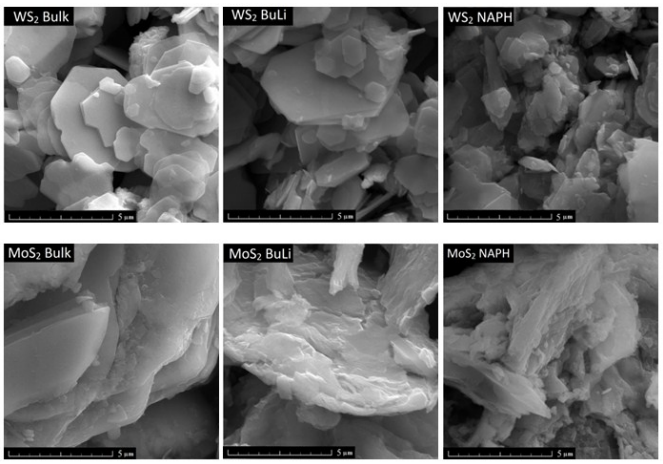

Figure SI-1. SEM images of bulk TMDs before chemical exfoliation (left), after the chemical exfoliation with butyllithium (center) and after the chemical exfoliation with sodium naphtalenide (right). Scale bars correspond to 5 μm.

Table SI-1. The results of deconvolution of high resolution XPS spectra of Mo 3d and W 4f peak in bulk MoS_2 and WS_2 used for exfoliation procedure.

Sample	1T (at. %)	2H (at. %)	M^{6+} (at. %)
MoS_2 Bulk	1.8	89.8	8.4
WS_2 Bulk	-	89.7	10.3

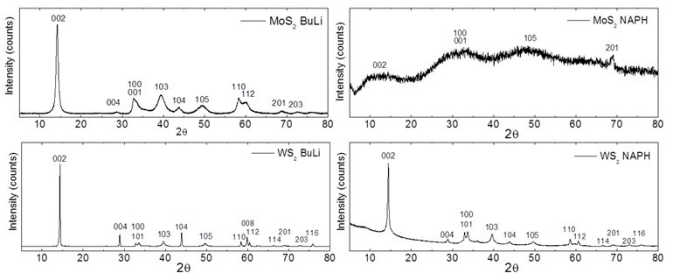

Figure SI-2. XRD patterns of MoS_2 and WS_2 exfoliated with BuLi and NAPH..

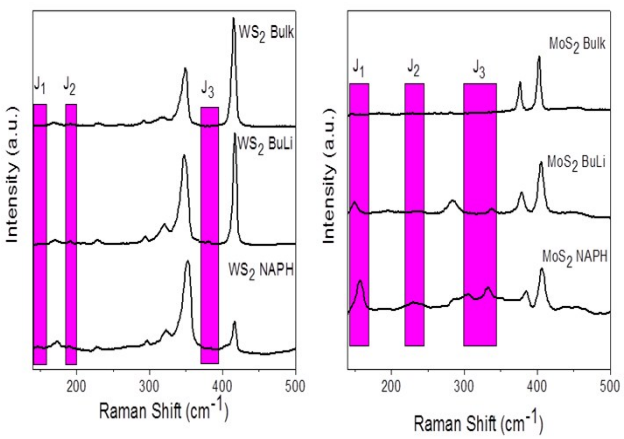

Figure SI-3. Raman spectra in the low frequency region. Pink regions J_1, J_2 and J_3 show vibrational modes present in 1T phase TMDs modifications.

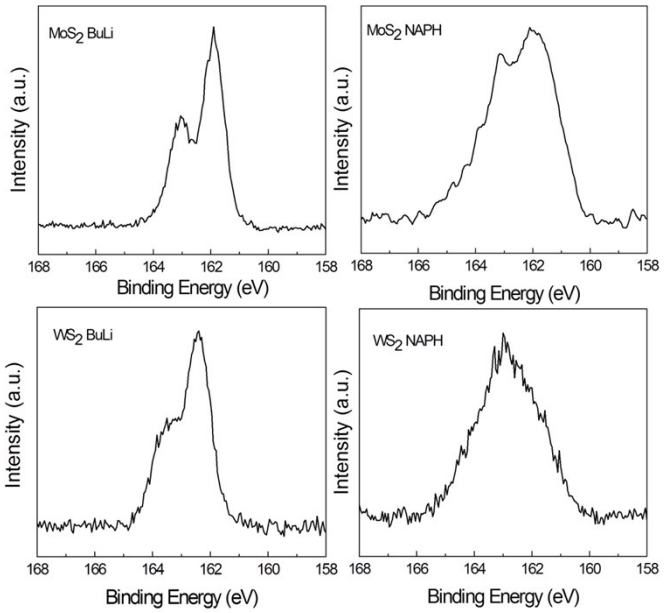

Figure SI-4. High resolution XPS spectra of S 2p in MoS_2 and WS_2 exfoliated with butyllithium and sodium naphtalenide.

Table SI-2. The composition obtained from survey spectra analysis of exfoliated TMDs. The Au 4d peak originates from the sample holder and C 1s and O 1s peak from the surface contamination.

Sample	O 1s (at. %)	C 1s (at. %)	Mo 3d (at. %)	W 4f (at. %)	S 2p (at. %)	Au 4d (at. %)	Chalcogen to metal ratio
WS_2 BuLi	3.4	33.4	-	13.6	37.8	11.9	2.78
WS_2 NAPH	20.3	29.7	-	13	32	5.1	2.46
MoS_2 BuLi	9.2	33.2	17.3	-	39.1	1.1	2.27
MoS_2 NAPH	16.4	42.2	9.7	-	18.5	13.2	1.9

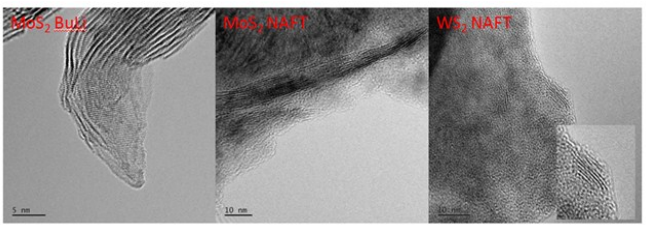

Figure SI-6. The wrinkled structure observed on the edges of MoS_2 sheets exfoliated with butyllithium and sodium naphtalenide and WS_2 sheets exfoliated with sodium naphtalenide.

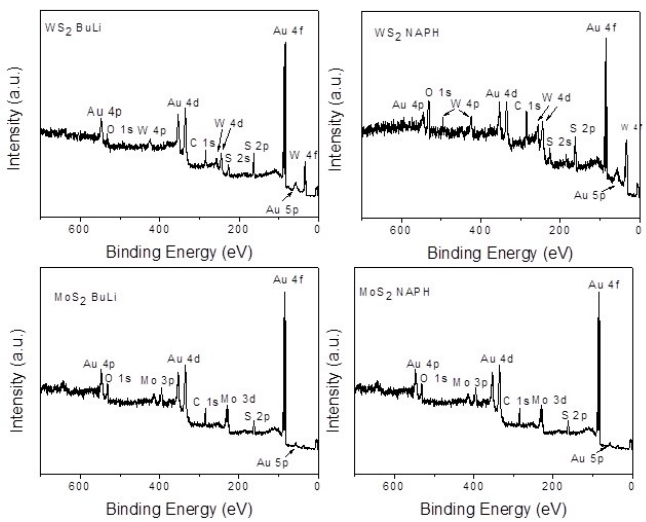

Figure SI-5. The survey spectra of MoS_2 and WS_2 exfoliated with butyllithium and sodium naphtalenide**.**

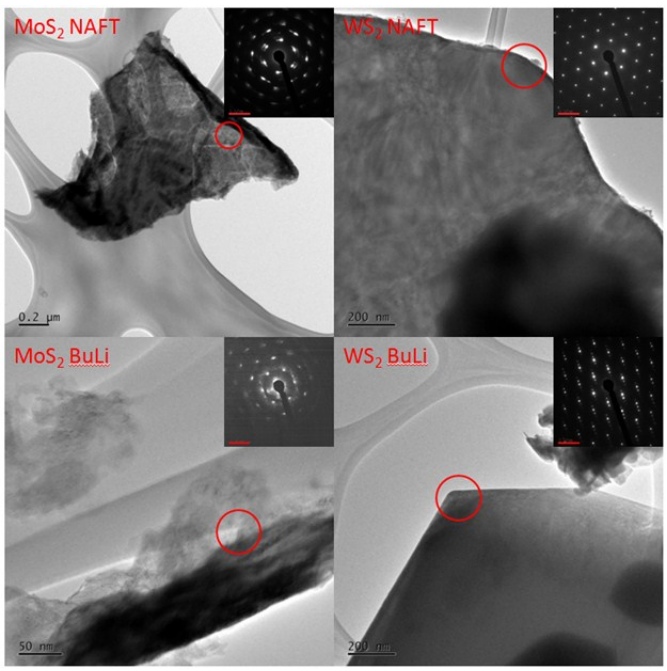

Figure SI-7. The TEM image of MoS_2 and WS_2 exfoliated with butyllithium and sodium naphtalenide, respectively. The insert is SAED corresponding to the red marked area. The scale bar of SAED image corresponds to 5 nm^{-1}.

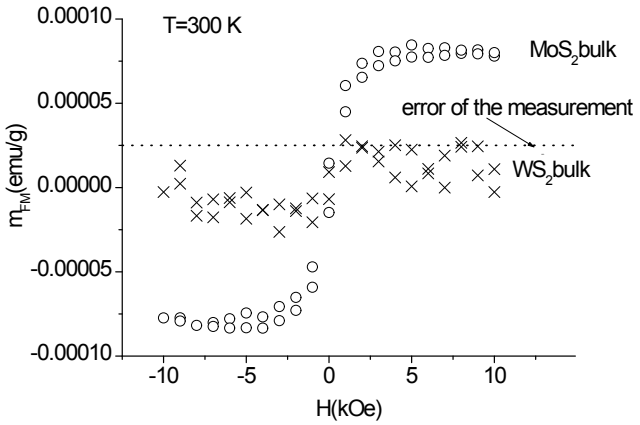

Figure SI-8. Room temperature magnetization measurement for bulk MoS_2 and WS_2 used for exfoliation.

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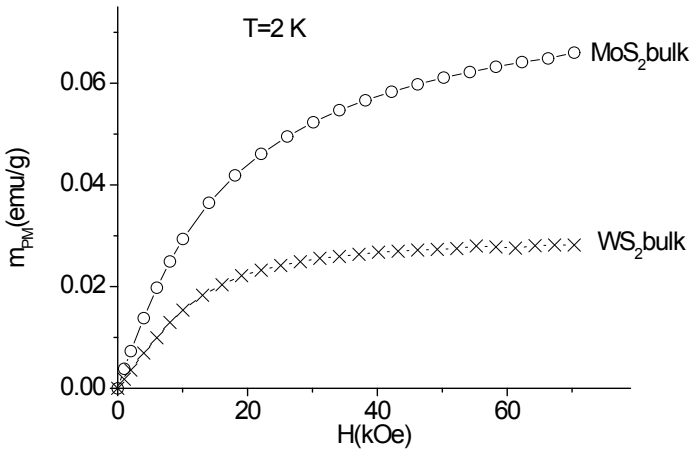

Figure SI-7. The magnetization of bulk MoS_2 and WS_2 measured at 2 K.

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