

Water influence in the preparation and stabilization of high quality phosphorene flakes

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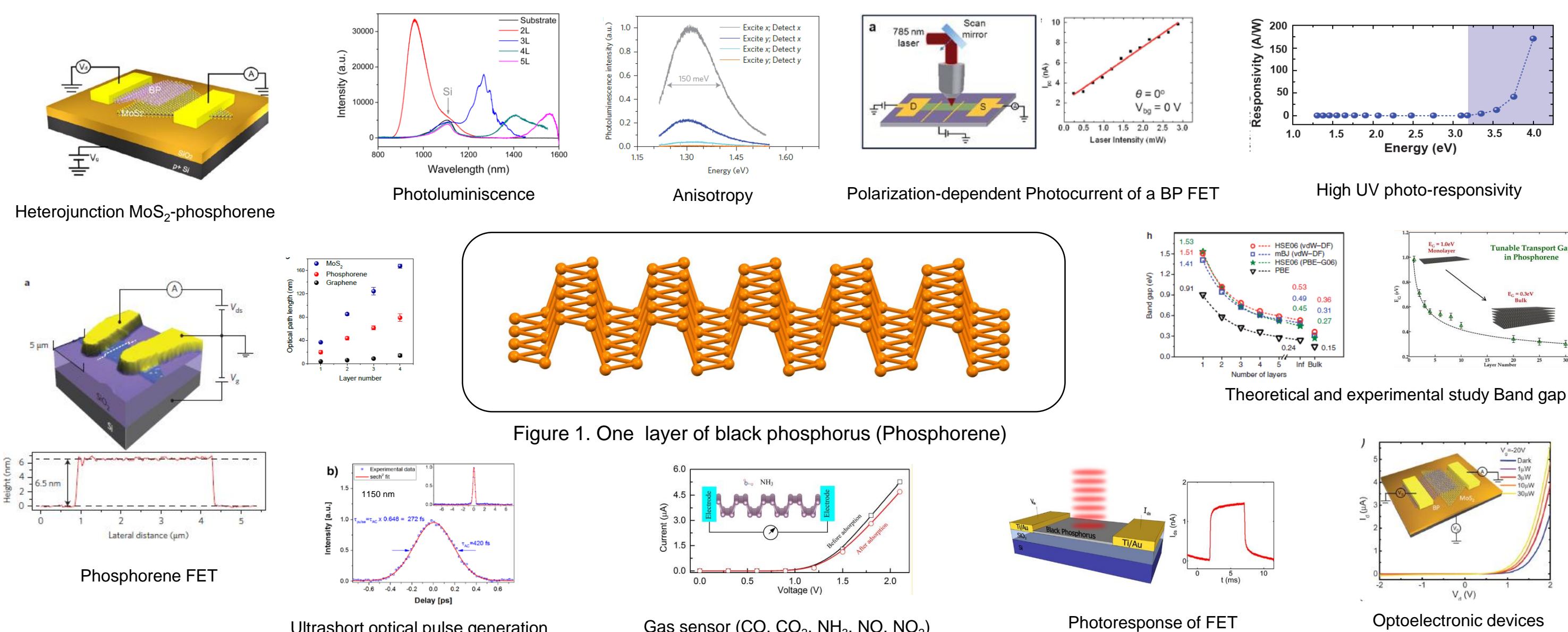
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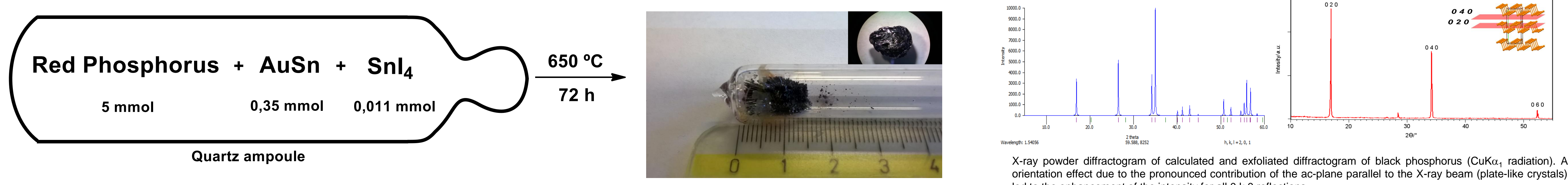
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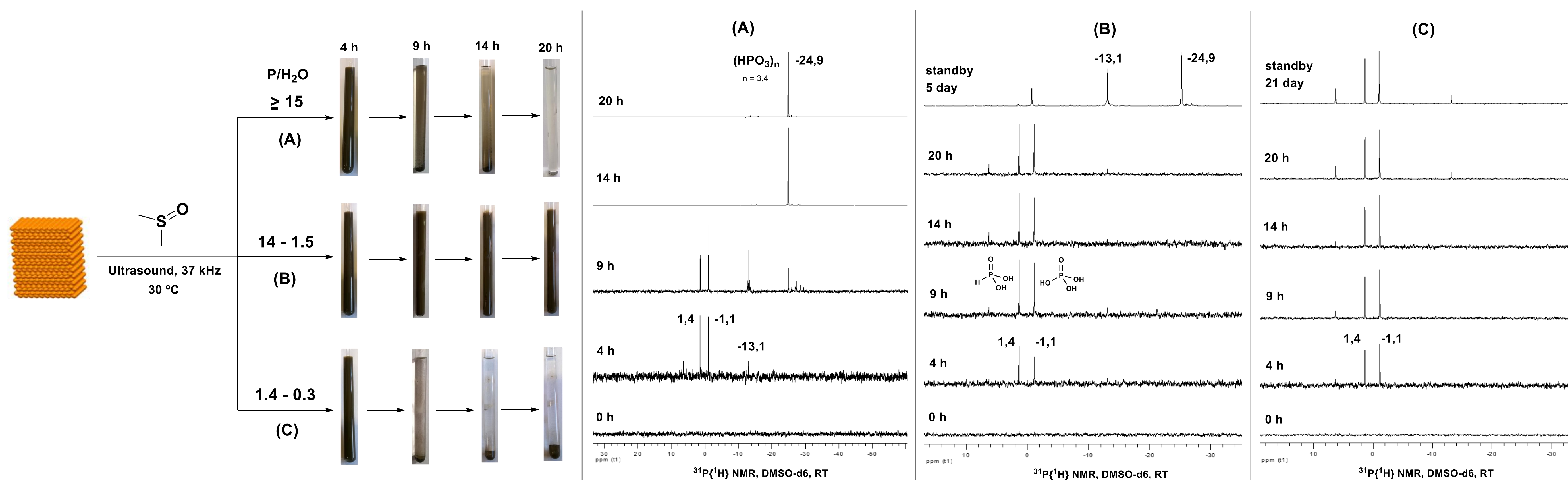
2D nanomaterials are very promising in nanodevice applications due to their surprising properties such as high electric mobility, outstanding structural properties and large specific surface area.^[1] Recently, phosphorene (Figure 1), the all-P counterpart of graphene, has been prepared starting from black phosphorus (BP).^[2] Small amounts of single and few layers sheets of the new material have been obtained by either micromechanical cleavage (Scotch tape method) or liquid exfoliation.^[3]



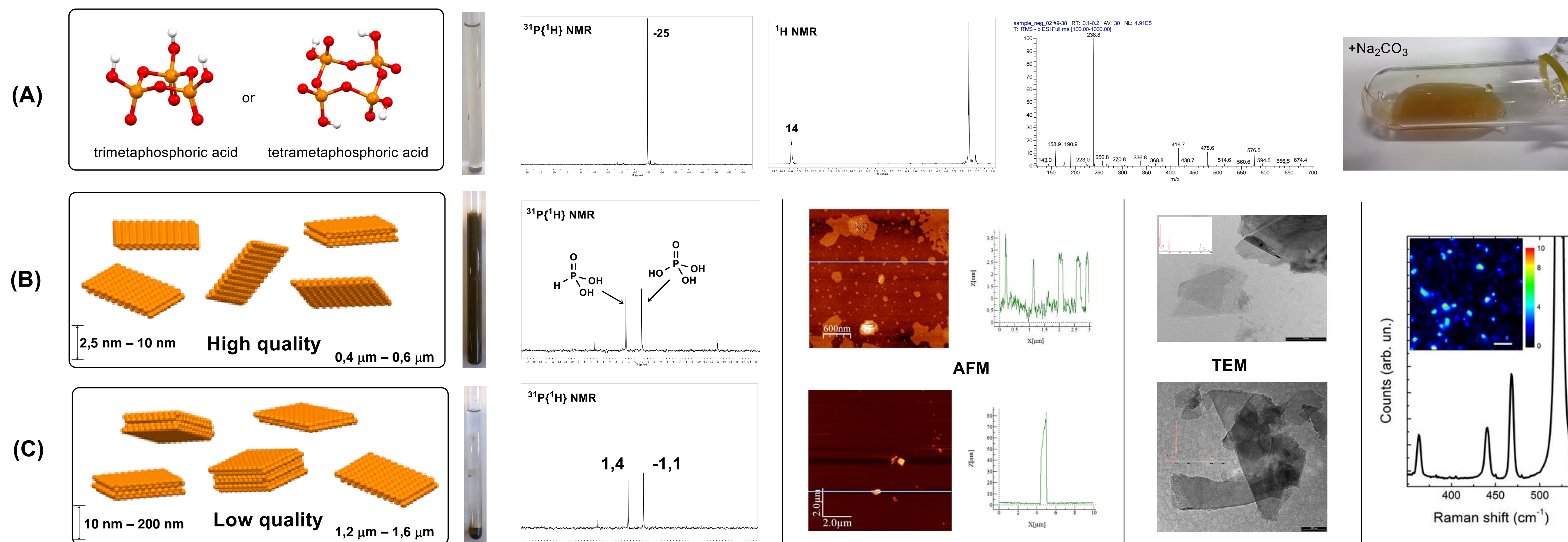
Synthesis of Black Phosphorus^[2]



Water influence in the exfoliation of Black Phosphorus in DMSO^[4]



Characterization of exfoliated BP^[4]



References

- (a) S. Das, W. Zhang, M. Demarteau, A. Hoffmann, M. Dubey, A. Roelofs, *Nano Lett.* **2014**, *14*, 5733-5739 and references therein; (b) S. Z. Butler, S. M. Hollen, L. Cao, Y. Cui, J. A. Gupta, H. R. Gutierrez, T. F. Heinz, S. S. Hong, J. Huang, A. F. Ismach, E. Johnston-Halperin, M. Kuno, V. V. Plashnitsa, R. D. Robinson, R. S. Ruoff, S. Salahuddin, J. Shan, L. Shi, M. G. Spencer, M. Terrones, W. Windl, J. E. Goldberger, *ACS Nano* **2013**, *7*, 2898-2926; H. Liu, Y. Du, Y. Deng, P. D. Ye, *Chem. Soc. Rev.* **2015**, *44*, 2732-2743; M. Buscema, J. O. Island, D. J. Groenendijk, S. I. Blanter, G. A. Steele, H. S. J. van der Zant, A. Castellanos-Gomez, *Chem. Soc. Rev.* **2015**, *44*, 3691-3718.
- (a) S. Lange, P. Schmidt, T. Nilges, *Inorg. Chem.* **2007**, *46*, 4028; (b) T. Nilges, M. Kersting, T. Pfeifer, *J. Solid State Chem.* **2008**, *181*, 1707.
- (a) H. Liu, A. T. Neal, Z. Zhu, D. Tomanek, P. D. Ye, arXiv:1401.4133v1 [cond-mat.mes-hall]; (b) L. Li, Y. Yu, G. J. Ye, Q. Ge, X. Ou, H. Wu, D. Feng, X. H. Chen, Y. Zhang, arXiv:1401.4117v1 [cond-mat.mtrl-sci]; (c) J. R. Brent, N. Savjani, E. A. Lewis, S. J. Haigh, D. J. Lewis, P. O'Brien, *Chem. Commun.* **2014**, *50*, 13338; (d) P. Yasaei, B. Kumar, T. Foroozan, C. Wang, M. Asadi, D. Tuschel, J. Ernesto Indacochea, R. F. Klie, A. Salehi-Khojin, *Adv. Mater.* **2015**, *27*, 1887.
- M. Serrano-Ruiz, M. Caporali, A. Ienco, V. Piazza, S. Heun, M. Peruzzini, *Adv. Mat. Interface* 2015, submitted

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