Lucie Ries – 2nd year

Thesis director: Philippe Miele, Damien Voiry

Two-dimensional materials as building blocks for membrane separation

Membrane separation technology plays an important role in various fields including water treatment, gas separation for the recovery and purification in many industrial processes, and food processing. There has been a renewed focus on multilayered membranes fabricated using exfoliated-restacked 2D materials, since their atomic thickness could theoretically lead to enhanced separation performance[1].

Exfoliated nanosheets of transition metal dichalcogenides (TMDs) constitute an attractive platform as 2D-material based membranes. Well above other TMDs, recent works were carried on molybnenum disulfide (MoS_2)[2]. Its lamellar structure similar to that of graphene shows rather improved stability. In addition, chemical modifications of the surface of the nanosheets have opened up new separation properties in both fields of molecular[3] and gas sieving. Yet the influence of these modifications on the separation performance remains unclear.

We have studied the performance of lamellar MoS_2 membranes towards the separation of various chemical species. In order to assess the role of surface chemistry, we developed strategies to covalently functionalize MoS_2 nanosheets[4]. Here we will present our recent investigations on the performance of lamellar membranes based on chemically exfoliated MoS_2 and the role of its covalent functionalization towards the sieving of molecules. Our results open novel directions for fine tuning the sieving behavior of membranes based on 2D materials.

[1] *C. N.Yeh J. X. Huang, Nat. Chem.*, ***2015***

[2] *M. Deng, H.G. Park, Nano Lett.*, ***2017***, *17 (4), pp 2342–2348*

[3] *L. Sun, X. Peng, ACS Nano*, ***2014***, *8 (6), pp 6304-6311*

[4] *D. Voiry, M. Chhowalla, Nature Chemistry, 2015, 7, pp 45–49*