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Graphene nanoplatelets attain a stable orientation in a shear flow: an investigation on the role of Brownian fluctuations[1] CATHERINE KAMAL, SIMON GRAVELLE, LORENZO BOTTO, Queen Mary University of London — We study theoretically the rotational dynamics of a rigid graphene nanoplatelet suspended in a simple shear flow. We have recently shown that in the infinite Peclet number limit a rigid platelet presenting the interfacial hydrodynamic slip properties of graphene does not follow the periodic rotations predicted by Jefferys theory, but rather aligns itself at a small inclination angle α_c with respect to the flow. This unexpected result is due to the low tangential friction at the graphene-solvent surface (the slip lengths for many 2D materials/solvent combinations can amount to several tens of nanometers). By analyzing the Fokker-Plank equation for the orientational distribution function for decreasing Peclet numbers, we show that the platelet fluctuates about α_c until a slip length dependent critical Peclet number is reached. Below this value, Brownian forces are large enough to produce full rotations, bringing the particle outside of a hydrodynamic potential well. In the stable region, the effective viscosity of a dilute suspension of graphene platelets is predicted to drop by at least a factor of 2 for typical slip length values.

[1]ERC project: FLEXNANOFLOW

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