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Solid lubricant coatings: challenges and open questions

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The friction of solids is an extremely complex and multiscale problem. Simulations of friction at the atomic scale have just started and still have to unravel their full potential; moreover, experimental validation is an ongoing challenge. Recent advances in 2D materials, such as graphene or transition metal dichalcogenides, opens, perhaps for the first time, the possibility for bottom-up design of frictionless material.
2D materials may readily be used as lubricants in nanoscale contacts, but their applicability as externally supplied lubricants in mainstream engineering applications is questionable. Preferably, low dimensional materials minimizing friction should be produced continuously during the sliding process. We show our recent results on solid lubricant coatings with self-adaptive nanostructure. Our ultimate ambition is to prepare thin films, which will produce an ultra-low friction interface based on optimised low-dimensional structures in situ, i.e. during sliding
We try to establish links between fundamental properties of selected 2D materials obtained by ab initio methods (electronic structure, covalency, etc.), molecular dynamics and the intrinsic friction. These results, together with nanoscale experiments, form a base of design of novel sputtered solid lubricant coatings.

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