Transition metal dichalcogenides (TMD's) have attracted considerable attention due to their self-lubricant properties. TMD’s exhibit low friction thanks to their anisotropic layered structure, where the adjacent lamellae with strong covalent bonding interact through relatively weak van der Waals forces. They are usually applied as solid lubricant, as oil additives or prepared as thin films to decrease friction energy losses in mechanical systems. The friction coefficient, extremely low in vacuum and to some extent in dry non-reactive gases, significantly deteriorates in the presence of air humidity. Unfortunately, this drawback together with their low load-bearing capacity, limits their use to very specific working conditions. This talk is aimed on the complex analysis of a new class of TMD’s alloyed with carbon prepared by magnetron sputtering. The coatings exhibit extremely low friction coefficient together with high load-bearing capacity. The friction coefficient is still environment dependent; nevertheless, the negative effect of air humidity is significantly reduced. Special attention has been paid to the analysis of the frictional and wear mechanisms under different operating conditions, such as contact pressure, air humidity or temperature. Nanoscale analysis of the wear track reveals the formation of a thin tribolayer exclusively consisted of TMD platelets parallel to coating surface. It has been concluded that the frictional properties of TMD-C coatings are almost exclusively driven by the formation of a TMD tribolayer, while the carbon is gradually removed from the contact area. The role of carbon in the wear process is thus only indirect by increasing coating hardness and density.