Nanomaterials as lubricant additives for more efficient and more environmentally friendly engine lubricant

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Abstract

There has been growing interest in nanoparticles for tribological applications over the past 20 years. Studies have shown the remarkable lubricating properties, viz., friction-reducing and anti-wear, of these small objects. This makes them potential candidates for replacing the molecular lubrication additives currently used in automobile lubricants, known to be pollutants and less efficient in some specific conditions. This has not gone unnoticed to the oil companies and the car manufacturers. All of them are faced with the problem of providing lubricants that meet the needs of the technological evolution of engines while respecting ever stricter environmental norms. Among the nanoparticles with proven tribological performance are carbon nanotubes and onions, boron nitride nanoparticles, and Inorganic Fullerene-like (IF) metal disulfides (IF-MoS_2, IF-WS_2). The latter exhibit the best friction-reducing and anti-wear properties ever observed. These nanoparticles have been the subject of detailed investigation in the lab for more than fifteen years now, and during this time, many key issues have been tackled, such as the conditions leading to these properties, the lubrication mechanisms coming into play, and the influence of parameters such as size, structure, and morphology of the nanoparticles on their tribological properties and the lubrication mechanisms. These years of research have given us a good understanding of the way these nanoparticles behave, and we can now identify the key parameters to be adjusted when optimizing their lubrication properties.

During this presentation the performance and the lubrication mechanism of the metal disulfide nanoparticles will be presented and we will see how to move from the nanoparticle to the development of new highly efficient nanolubricants for automotive applications (engine and gearboxes).

Image

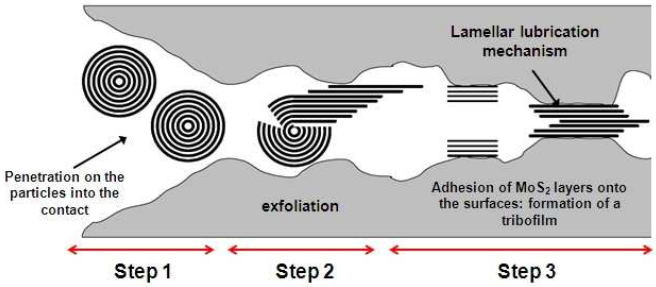


Figure 1: Lubrication mechanism of the inorganic fullerene-like metal disulfide nanoparticles

Recent Publications (minimum 5)

1. Jenei I, Dassenoy F (2017) Friction Coefficient Measured on a Single WS_2 Nanoparticle: An In Situ Transmission Electron Microscope Experiment. Tribology Letters 65, 86, 2-8.
2. Ussa Aldana P, Dassenoy F, Vacher B, Le Mogne T, Thiebaut B (2016) WS_2 nanoparticles anti-wear and friction reducing properties on rough surfaces in the presence of ZDDP additive. Tribology International, 102, 213-221.
3. Ussa Aldana P, Dassenoy F, Vacher B, Le Mogne T, Thiebaut B, Bouffet A (2016) *Antispalling Effect of WS_2 Nanoparticles on the Lubrication of Automotive Gearboxes*. Tribology Transactions, 59, 1, 178-188.
4. Rabaso P, Dassenoy F, Ville F, Diaby M, Vacher B, Le Mogne T, Belin M, Cavoret J (2014). An Investigation on the Reduced Ability of IF-MoS_2 Nanoparticles to Reduce Friction and Wear in the Presence of Dispersants. Tribology Letters, 55, 3, 503-516.
5. Lahouij I, Bucholtz E, Vacher B, Sinnott S, Dassenoy F (2012) Lubrication mechanisms of hollow-core inorganic fullerene-like nanoparticles: coupling experimental and computational works. Nanotechnology, 23, 375701.



Biography

Holding a PhD in Materials Science (1999) from the Paul-Sabatier University of Toulouse (France), Fabrice Dassenoy spent three years (2000-2002) at the Max-Planck Institute of Berlin (Germany) – Surface Physics Department - before joining École Centrale de Lyon first as Assistant Professor (2002-2011) before getting promoted to Professor (2012). As an expert in nanomaterials, his research conducted at the Tribology and System Dynamics Laboratory (LTDS) is related to the study of the tribological properties of nanoparticles used as lubricant additives, with a particular interest in understanding the lubrication mechanisms of these nanomaterials and in the optimization of their lubricating properties, especially for automotive applications. He has published more than 50 articles and 4 patents in this field and got in 2009 the Taiho Encouraging Award for Young Tribologists. He teaches Materials Science at École Centrale de Lyon with a focus on the characterisation techniques. He is currently in charge of a research group called "Understanding Fundamental Phenomena in Tribology".

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