

Nanodiamond-based Nanospacer Lubricants

Summary

North Carolina State University and the International Technology Center (U.S.), the NanoCarbon Research Institute (Japan), and the Ural Federal University (Russia) will develop and implement a breakthrough nanotechnology based on detonation nanodiamond (DND) particles as robust and effective anti-friction and anti-wear additives that will increase the durability of a wide range of industrial and transportation systems as well as enhance transportation fuel efficiency. A key element is the use of individual 4nm DND particles of rounded shape that act as nanospacers that reduce friction by rolling. DNDs are among the most promising nanoparticles as super-hard and slick lubrication additives capable of virtually eliminating wear and drastically reducing friction (5-10 times) of sliding interfaces as shown in recent laboratory tests by our team. If this level of reduction in friction and wear is achieved in large mechanical systems, including combustion engines, the lifetimes and energy efficiency of these systems will increase dramatically, leading to replacement of fewer broken parts and overall lower manufacturing costs. Estimates suggest that if all US car owners used engine oil that produced only a 0.5% fuel economy improvement, the total cost savings would be \$370 million per year. Thus the current project is aimed at providing the following global benefits: (i) reduced manufacturing costs through enhanced durability of sliding mechanical systems, (ii) reduced oil consumption through increased lubricant longevity, and (iii) reduced fuel consumption. Reduced fuel consumption will also lead to reduced greenhouse gas emissions in industrial and transportation systems. The project will synergistically combine experimental and simulation efforts that will lead to a comprehensive model of DND action mechanisms as well as commercial products of the DND nanospacer lubricant additives.