# Fluorinated nanodiamond and soot in tribological applications

Shenderova O.A.*[1], Ivanov M.G.[2], Deev L.E.[3], Ivanov D.M.[2]

[1]*International Technology Center, 27615, Raleigh, USA*
[2]*Ural Federal University, 620002,Yekaterinburg, Russia*
[3]*«RSC « Applied Chemistry», 614034, Perm, Russia*
**e-mail: oshenderova@itc-inc.org*

Different types of additives, including nanoparticles, are used with lubricants in order to reduce friction and wear as well as to increase the load carrying capacity of the lubricants. Detonation soot (a mixture of nanodiamond particles with different forms of $sp^2$-bonded carbon) has been used in commercial Class I oils for more than 2 decades and well purified nanodiamond (ND) particles demonstrated recently impressive antifriction and antiwear properties in polyalphaolefin (PAO) oils [1, 2]. Colloidal stability of nanoadditives in an industrial oil is the paramount requirement for their tribological applications. ND particles can be modified to enhance the stability of their dispersions in a suitable carrier or liquid, and provide chemical compatibility for oil. Particularly, fluorine-modified NDs demonstrate enhanced colloidal stability in oils. The introduction of fluorine-containing constituents result in enhanced lubricity and chemical stability under extreme conditions.

In the current work, treatment of detonation ND (DND) and detonation soot (F-DND and F-soot) in the flow of $F_2$ and $SF_4$ was performed, resulting in up to 8 at.% of fluorine in the DND composition. Mixtures for tribological tests were prepared using PAO-6 as the base oil. Fluorinated DND and soot were dispersed in PAO using fluorine-containing dispersant. Combinations of fluorinated DND with fluorine-containing dispersant in PAO with hexagonal boron nitride h-BN particles were also prepared for a comparison. Testing has been performed on these formulations using ring-on-ring (friction coefficient) and four ball tests (extreme pressure (EP) failure load and diameter of wear spot).

Fluorine-containing NDs and soot demonstrated superior tribological properties as compared to the pristine non-functionalized particles and h-BN additive used alone.

[1] M.G. Ivanov, S.V. Pavlyshko, D.M. Ivanov, I. Petrov, G. McGuire, O. Shenderova, *Mater. Res. Soc. Symp. Proc.* **1203**, 1203-J17-16 (2010).

[2] M.G. Ivanov, S.V. Pavlyshko, D.M. Ivanov, I. Petrov, O. Shenderova, *JVST. B* **28**(4), 869 (2010).