Nanocomposites and nanomaterials

Wear resistant graphene nanocomposite coatings based on LCP/PAI hybrids

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Continuous development of technology requires creating of new materials with superior performance and applicability in critical conditions. The qualities of superior thermo-mechanical properties, high strength and stiffness, high chemical and gamma radiation resistance, good dimensional and extraordinary hydrolytic stability, excellent barrier properties, and low linear thermal expansion coefficient of al-aromatic Liquid Crystal Polymers (LCPs) make them attractive high performance coating materials suitable for applications under extreme conditions [1]. However, processing of LCPs require extremely high temperatures. Furthermore, LCPs have relatively poor adhesion to metal substrates. Moreover, too thick LCP-coatings have increased brittleness and reduced wear resistance.

The goal of this work was to develop new LCP based coatings with improved sliding wear resistance and adhesion to metal substrates by hybridization of LCP with high-performance Polyamide-Imide (PAI) resin and reinforcement with Nanographene (NG). Because of high chain stiffness and inter-molecular hydrogen bonding, aromatic PAIs possess high thermal stability, chemical and corrosion resistance, good mechanical, electrical and oxidative properties, good adhesion to metals. Therefore, they are excellent candidates as high temperature films, coatings, binder for high-performance paints, lubricants, adhesives and fibers for aerospace applications [2]. Furthermore, PAIs are able to align liquid crystals.

Recently Sumitomo Chemical developed a novel, up to date an unique in the world all-aromatic LCP type soluble in aprotic solvents. This allowed us to develop versatile NG reinforced LCP/PAI hybrid coatings with improved adhesion to metal substrates and sliding properties using low-temperature co-solvent processing route. Obvious improvement was achieved even for thick coatings containing very low concentration (e.g. 0.05 wt.%) of NG.

1. *Donald A.M., Windle A.H.* Liquid crystalline polymers. Cambridge: Cambridge University Press. 1992.
2. *Dezern J.F., Gautreaux C.R.* Synthesis and Characterization of Polyamide-Imides // Polym Eng Sci.-1991.**-31.**-P. 860-866.