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A report "**Rheology and processing of polymer nanocomposites with graphene and other 2D materials**" was presented by ***Dr. Ricardo Andrade*** from **Mack Graphe Centre, University Mackenze, Sao Paolo, Brazil.**

Summary

Bi-dimensional (2D) nanomaterials became of great interest, scientific and technologically, due to their unique properties, after graphene was isolated in 2004. These unique properties make them extremely appealing to process polymer nanocomposites, due to their polymer-nanofiller interactions. These nanocomposites have been found to possess promising properties such as mechanical, barrier, thermal, and electrical. These properties are advantageous for applications in the field of food packaging, automotive, airplane, sport products, textile, electronic devices, membranes, and coatings/inks. Among the different methodologies of incorporate 2D nanofillers in a polymer matrix, melt blending is usually the most economical and industrial approach when compared with others. However, the effective reinforcement of polymers is still a challenge due to the poor dispersion and the strong interfacial adhesion between the nanofiller and the polymeric matrix.

In this study, we used different strategies to disperse 2D materials into polymer matrix by using a twin screw extruder. The influence of the methods, processing parameters, particles concentration, level of particles dispersion and polymer nanocomposite properties were evaluated with the aim to understand the thermodynamics and the physical-chemical interactions that are involved in the mixing and dispersion process, with special attention to the rheological properties. Actually, it was observed these particles have a significant influence depending on their preparation and pre-exfoliation, which influences the nanocomposites rheological behavior. Depending on their exfoliation level, they can behave as a lubricant, where the viscosity decreases with the particles. The results showed that the strategies used here to prepare polymer nanocomposite are very efficient in order to obtain a good dispersion, and consequently, obtaining of a material with excellent properties at very low content (some cases less than 0.5% w/w).

Discussion

Prof. N. Antonova: What is the main application for these materials?

Answer: These materials dissipate the temperature very well. They are lighter than metals. Recently such composites are used in automotive cars and airplanes as well. Graphene composites can be used for electromagnetic shielding of mobile phones or other electronic devices.

Prof. V. Kavardjikov: Could you say something about the synergetic effects in such composites.

Answer: It could be physical. The particles are surrounded by the polymer and all effects are interfacial. The graphene has a huge surface area. That is why very low quantity of particles give significant effects. We work with graphene oxide and it have functional groups. Some other polymers can interact chemically.

Prof. V. Kavardjikov: If you know very good characteristics of these parts of composites, you can choose appropriate ones to control the final property.

Answer: Yes.

Prof. Kotsilkova: You used rheology as a tool to evaluate the exfoliation. Can you use rheology for interfacial interaction?

Answer: Yes, this is my next goal.

Prof. Kotsilkova: The "slipping effect" is very interesting. We found such effect at very high shear rates, low concentration and it is so effective. Do you think it depends on the technique or processing of the material?

Answer: Our extruder is very small, but the shear rate is higher than in normal extruders.

Prof. V. Vassilev: We are interested about modelling of pure material, Graphene flake, not the composite. Experiments with this size are impossible to do. I know for theoretic models.

Answer: We have people from photonics department and they do that. There are people in Singapore who do such tests.

Prof. V. Vassilev. How do you manage to fight against the Van-der-Vaals force that actually do opposite work?

Answer: We search for good solvents.

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