# HIGH-TEMPERATURE BEHAVIOUR OF SEGREGATED COMPOSITES BASED ON UHMWPE

*MaruzhenkoO.*[1], *MamunyaY.*[1,2], *IurzhenkoM.*[1], *PylypenkoA.*[2]
[1] E.O. Paton Electric Welding Institute National Academy of Sciences of Ukraine, Department of plastic welding, Kyiv, Ukraine
[2] Institute of Macromolecular Chemistry of National Academy of Sciences of Ukraine, Department of polymer composites, Kyiv, Ukraine, a.v.maruzhenko@gmail.com

Composites with a segregated structure based on UHMWPE attract the attention of researchers due to their high mechanical characteristics. However, the structure of composites and their behavior in a wide temperature range have not been sufficiently studied. In this work, the behavior of segregated UHMWPE composites in the high-temperature region containing mixed carbon fillers graphene (Gr) and anthracite (A), is analyzed.

The study of loss tangent of segregated composites with a hybrid type of filler, using the method of dynamic-mechanical analysis (DMA), in the high-temperature range revealed a noticeable peak ($T_{ht}$) in the temperature range of 195 $^{o}$C - 205 $^{o}$C (Fig.1a). Despite the temperature of the peaks $T_{ht}$, essentially exceeds the melting point $T_m$=135 $^{o}$C, the polymer shows a high elastic behaviour in the range between $T_m$ and $T_{ht}$, which can be explained by the high viscosity of ultrahigh molecular weight polyethylene and the segregated structure of the polymer matrix.

Probably, the nature of these peaks can be explained by the adhesion of particles what leads to the removal of the boundaries between the polymer grains at temperature $T_{ht}$ and to the formation of a continuous polymer matrix. This is confirmed by the polymer color change from the matte to the transparent at this temperature. An increase of the filler concentration reduces the intensity of the peak and leads to an increase in temperature $T_{ht}$ due to its own mechanical losses and containment of the process of disappearance of boundaries between polymer grains.

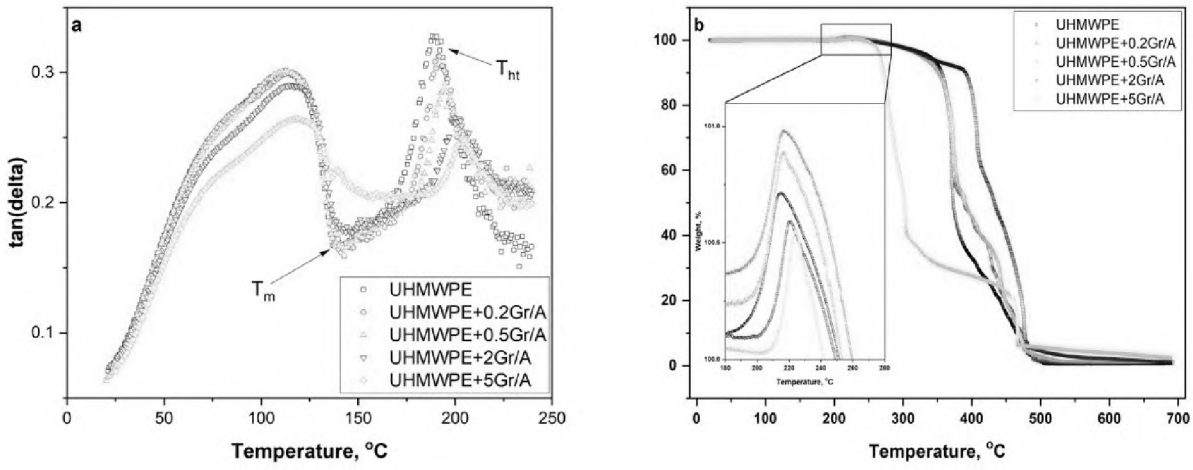


**Fig.1** Analysis of high-temperature behaviour of segregated composites (**a**) DMA results, (**b**) thermogravimetric analysis

Detailed analysis by thermogravimetric method (Fig.1b) shows the presence of a low-intensity peak in the range of temperature of 215 to 225 $^{o}$C, associated with oxidation of the sample, which increases its weight. Intense oxidation becomes possible when the polymer passes from the highly elastic state to the viscous flow, which occurs above the temperature $T_{ht}$. An increase of the filler concentration reduces the degree of oxidation and peak intensity.

Finally, it can be concluded that when melting UHMWPE at a temperature $T_m$, the composite remains in a highly elastic state and passes into a viscous state at a temperature $T_{ht}$, which is 80-90 $^{0}$C higher than the melting point. This transition is accompanied by the appearance of a $T_{ht}$ peak on the curve of the mechanical loss tangent. Intensive oxidation of the polymer begins at a temperature 20 $^{0}$C higher thanthe transition temperature $T_{ht}$.