Structure and thermophysical properties of nanocomposites based on polyethylene oxide and organoclay nanoparticles

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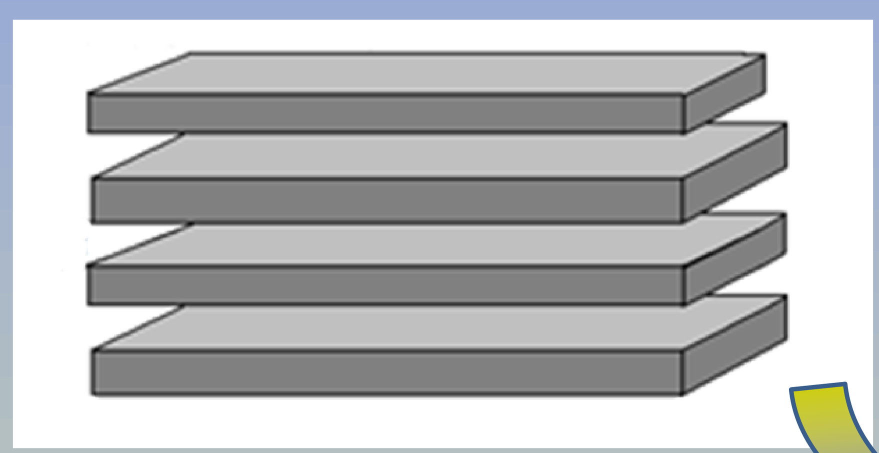
INTRODUCTION

Polymer nanocomposites containing organoclay nanoparticles have been the subject of intensive research for the past two decades. The growing interest in the study of these systems is due to the fact that they have better mechanical stability and higher thermal stability compared to other composite materials. The aim of this work was to study the influence of the nature and content of anisometric nanofillers of different morphology (montmorillonite (OMM) and laponite (OLP)) on the structure and thermophysical properties of nanocomposites based on polyethylene oxide (PEO).

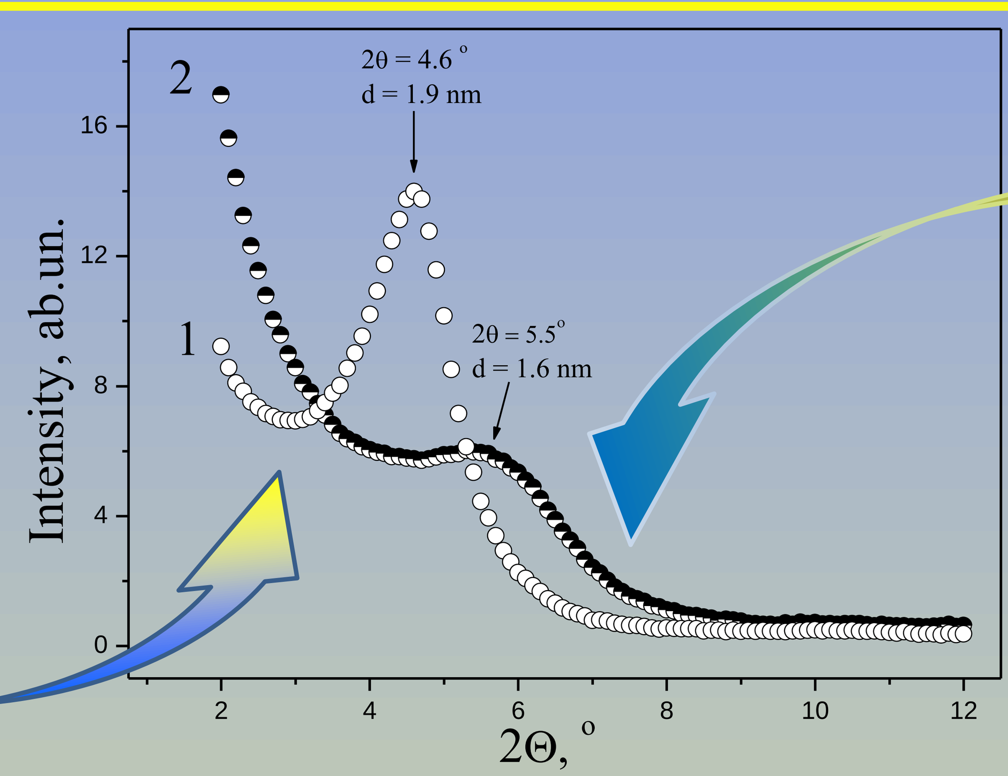
EXPERIMENTAL PART

Polyethylene oxide (PEO 10000), *HO* [-CH_2-CH_2-*O*-]$_n$*H* with molecular weight M_w = 10000, manufactured by Aldrich. The pristine montmorillonite (MM) and laponite were modified with the long chain cetyltrimethyl ammonium bromide ions ($(C_{16}H_{33}N(CH_3)_3)^+Br^-$, CTAB, Merck). Before use, the polymers were dehydrated by heating in vacuum for 2-6 hours at 80-100 °C at a residual pressure of 300 Pa. Nanocomposites were prepared by ultrasonic mixing in the liquid state using an ultrasonic dispersant UZD-650.

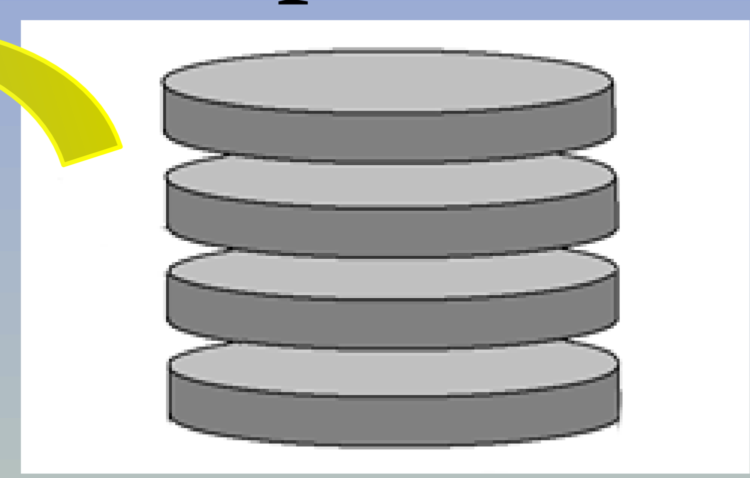
Montmorillonite



Intercalation

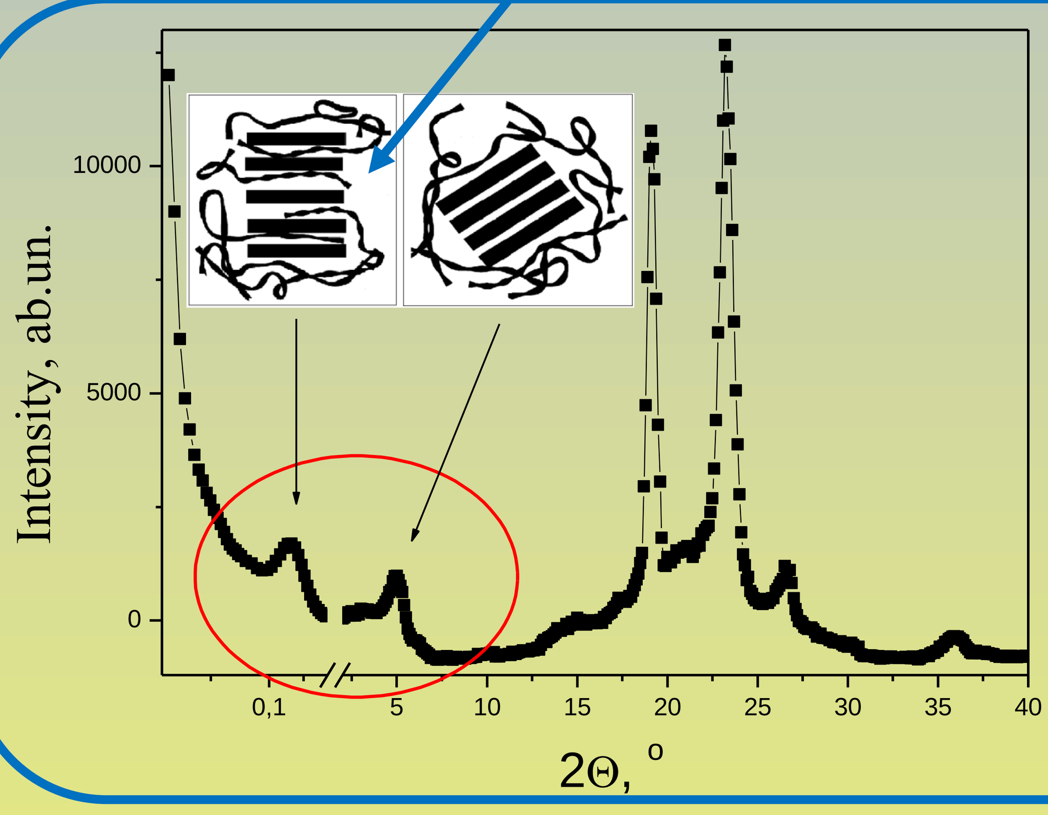


Laponite

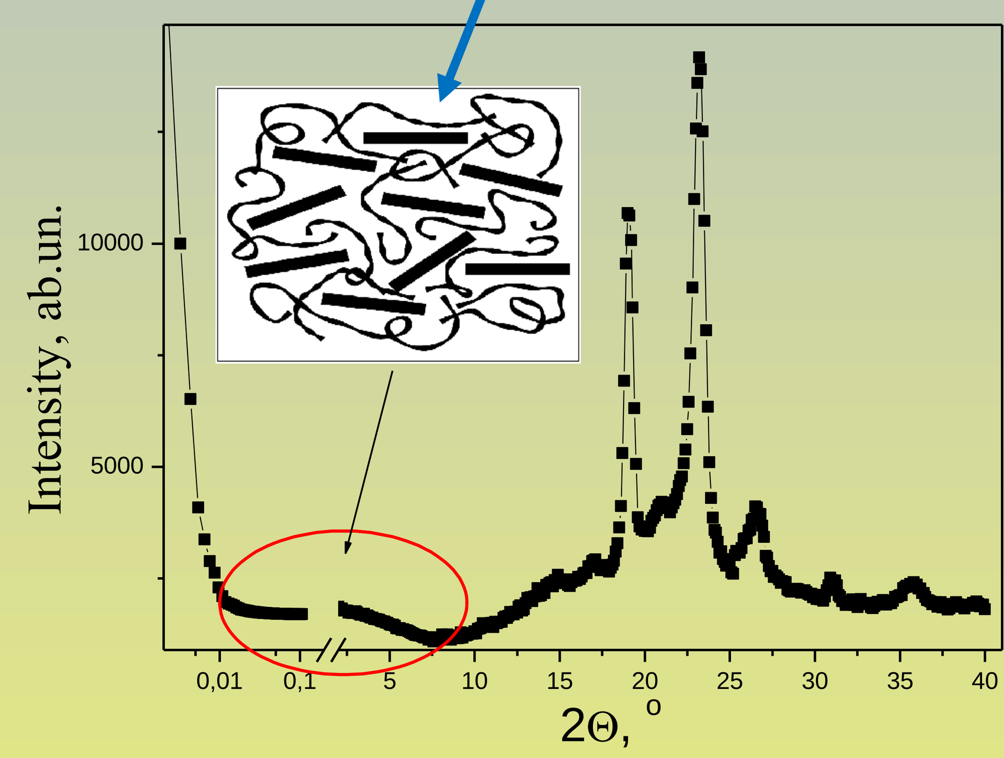


Exfoliation

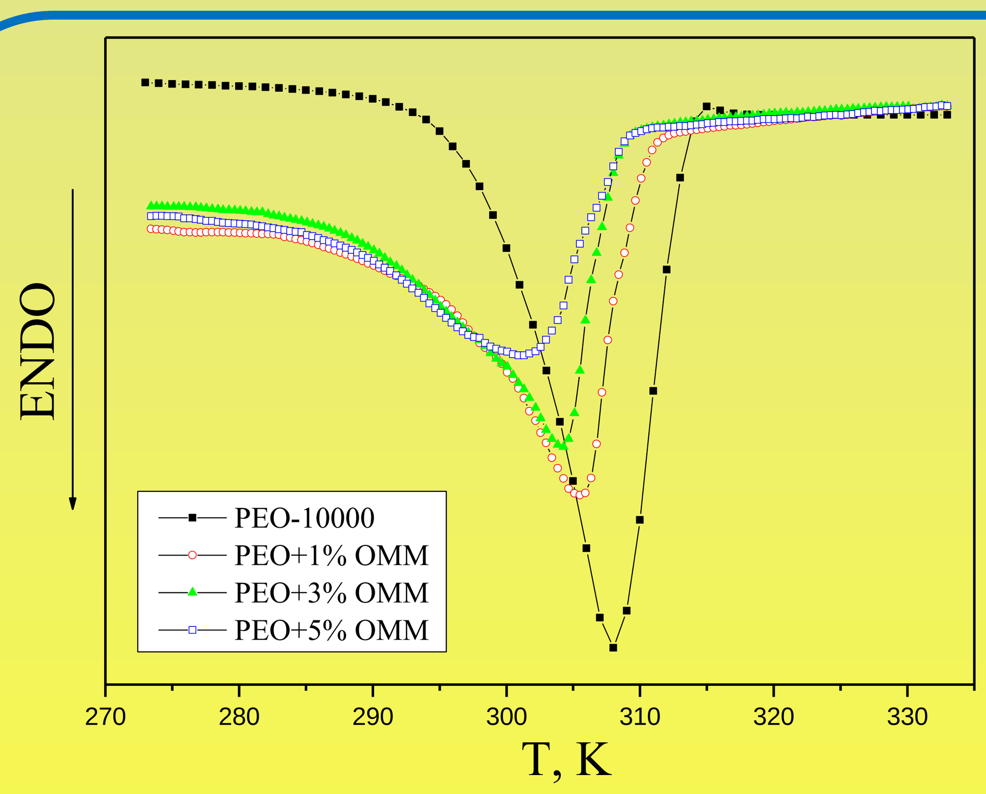
Structural features



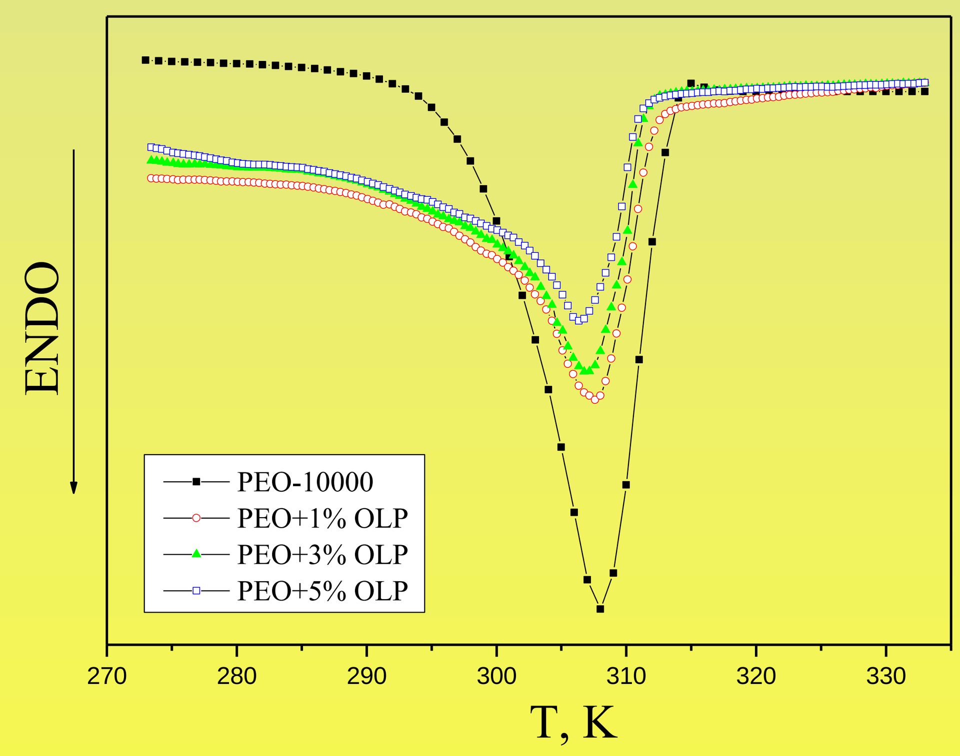
Sample	θ_m, ° ± 0,1 °	β,° ± 0,05 °	L, nm ± 0,05nm	χ_{cryst}, %
PEO	23,3	0,75	11,80	78,3
PEO-1% OMM	23,3	0,90	10,00	52,0
PEO-3% OMM	23,3	0,75	11,55	49,8
PEO-5% OMM	23,3	0,75	12,55	46,3
PEO-1% OLP	23,2	0,70	13,30	48,7
PEO-3% OLP	23,2	0,70	13,45	45,0
PEO-5% OLP	23,2	0,70	13,95	41,2



Thermophysial features



Sample	T_m, K	ΔH_m, J/g	χ_c, %
PEO	308,0	124,8	75,4
PEO-1% OMM	305,5	92,9	53,1
PEO-3% OMM	304,0	88,5	50,5
PEO-5% OMM	302,3	80,9	45,9
PEO-1% OLP	307,5	79,3	47,9
PEO-3% OLP	306,7	73,8	44,6
PEO-5% OLP	306,3	69,3	39,9



CONCLUSIONS

As a result of the research it was shown that the structure and thermophysical properties of nanocomposites based on PEO-10000 significantly depend on the nature and content of the layered silicate filler. It is established that in systems filled with OMM, partial intercalation processes take place, while in systems containing OLP complete exfoliation is observed. From the data of X-ray diffraction analysis and DSC it can be seen that the introduction of OLP leads to greater amorphization of the system than the introduction of OMM. The presence of OLP in the system, in contrast to OMM, promotes the formation of crystallites of larger size, which leads to an increase in the melting point of PEO-OLP nanocomposites.