

## Synthesis of PE/MgO nanocomposites via in-situ polymerization using Ziegler-Natta catalyst

Mohammad Mansouri, Navid Ramezani<sup>\*</sup>, Gholam Hossein Zohuri, Kimia Moghadari

Department of Chemistry, Faculty of Science, Ferdowsi University of Mashhad, Po. Box 91775-1436 Mashhad, Iran  
ramezani@um.ac.ir

**Abstract:** In order to prepare a nanocomposite of PE/MgO, in-situ polymerization of ethylene was carried out using a Ziegler-Natta catalyst ( $TiCl_4/MgCl_2$ ) in the presence of different content of magnesium oxide (0.1 and 0.42 weight percent) nano-particles (~20 nm). The result showed that activity of the catalyst slightly enhanced with increasing of MgO (0.1 w%) during the polymerization (from 427 to 688 g PE. mmol cat<sup>-1</sup>. h<sup>-1</sup>), however, further increase of the chemical (up to 0.42%) slightly decrease activity of the catalyst (500 g PE. mmol cat<sup>-1</sup>. h<sup>-1</sup>). The structural properties of the result products were studied using FTIR technique. The result showed that branching density and vinyl content of the product was increased with increasing of MgO particle to the reaction mixture.

**Keywords:** Ziegler-Natta catalyst, ethylene polymerization, nanocomposite

### Introduction

Nanocomposites have different phases, one of which is the phase of nanoparticles. Polymers are a matrix for composites because they can be designed for a variety of physical properties [1,2]. effect of mineral nanoparticles on properties of polymers is an attractive field of research which has great investigation these days. In-situ addition of minerals has significantly improved of properties of the polymers which is not possible to obtain in any other addition manner. The improvement are include better compatibility, between nanoparticles and polymer materials, better mechanical and electrical properties gained [3]. Nanocomposites, based on their matrix materials are divided into several classes. Particle-reinforced polymer are one of these classes in which particle reinforced polymer are one of these classes that are used by organic polymers such as polyolefin. The material have been of interest to the industry because of their lightness, good processing and low cost [4,5].

### Experimental

Polyethylene and polyethylene nanocomposite based on magnesium oxide were prepared via ethylene polymerization using the Ziegler-Natta catalyst ( $TiCl_4/MgCl_2$ ) in the presence of triethyl aluminum (TEA) as a cocatalyst. Polymerization reaction was performed to prepare both polyethylene and nanocomposite under the same polymerization conditions of 1.5 bar of ethylene monomer pressure, 700:1 molar ratio of cocatalyst to catalyst, polymerization time 60 min, and reaction temperature of 60 °C inside a round bottomed flask as a polymerization reactor.

### Results

The results of the FTIR spectrum analysis show that increasing of the MgO (0.1 to 0.42 w%) decrease of the CH<sub>3</sub> end polymer chain from 32.35 to 31.69% which indicated of a decrease in the number of branches in the polymer chain (the peak at 1367.18 related to the CH<sub>3</sub> of the end polymer chain). Study of catalyst activity show that with increasing of magnesium oxide nanoparticles (0.1 w%) the activity of the catalyst increased (from 427 to 688 g PE. mmol cat<sup>-1</sup>. h<sup>-1</sup>). The behavior represents the optimum activity, however, with further

increase of the magnesium oxide nanoparticles (0.42 w%) the activity was reduced ( to 500 g PE. mmol cat<sup>-1</sup>. h<sup>-1</sup>).

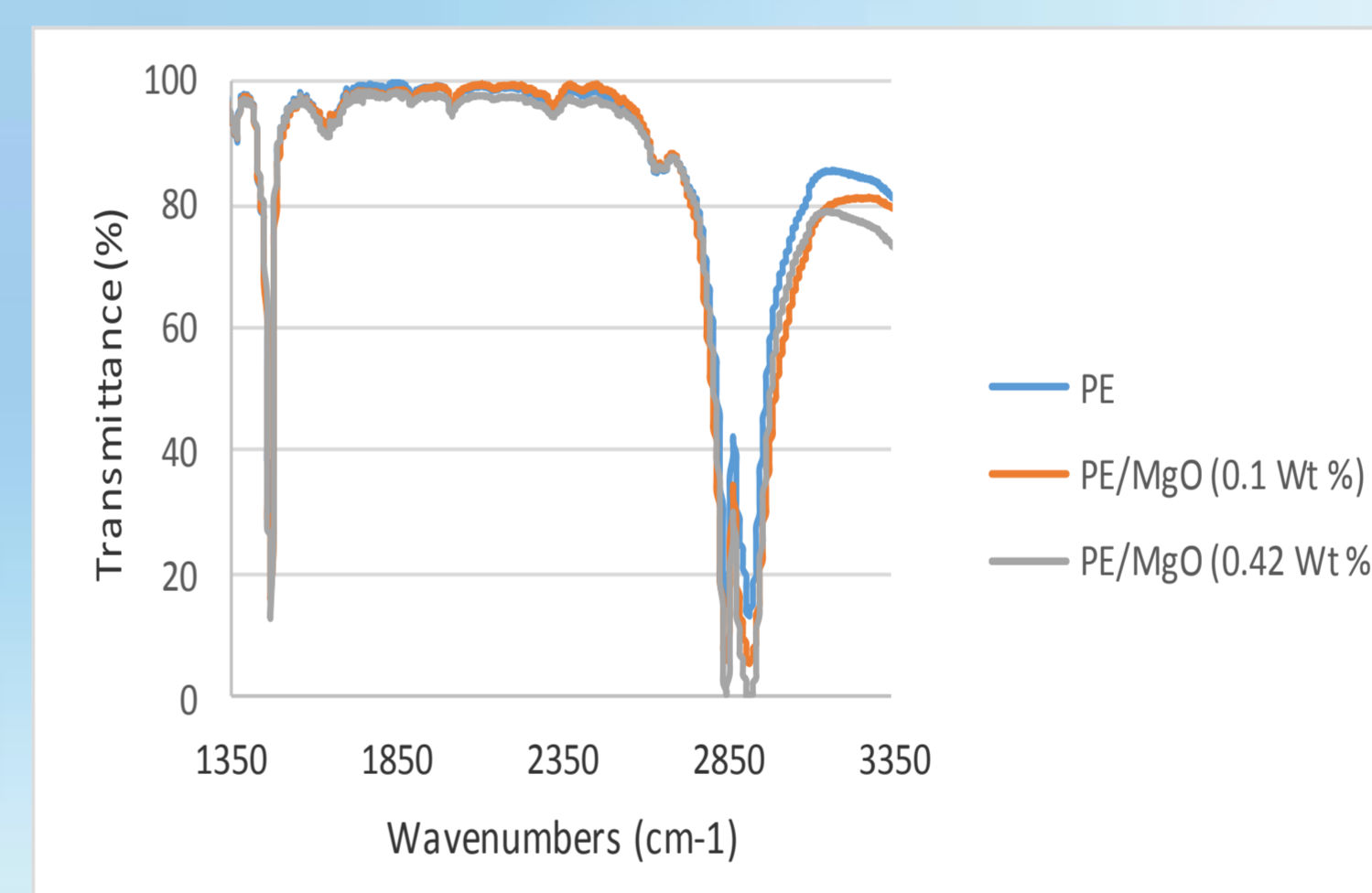


Fig. 1 FTIR spectrums of the PE and PE/MgO nanocomposites.

### Conclusions

The PE/MgO nanocomposites which was prepared using the Ziegler-Natta catalyst ( $TiCl_4/MgCl_2$ ), via an in-situ polymerization with different content of magnesium oxide nano-particles (20 nm), and TEA as cocatalyst, increasing of MgO shows an optimum activity of 688 g PE. mmol cat<sup>-1</sup>. h<sup>-1</sup>. The result from FTIR spectrum showed that both branching and unsaturated content of the resultant nanocomposites were augmented by raising of MgO nano-particle into the product.

### Acknowledgement

This work was supported by Department of Chemistry, Faculty of Science, Ferdowsi University of Mashhad (Project code: 3/46093), Mashhad, Iran which is appreciated.

### References

- [1] P. H. C. Camargo, K. G. Satyanarayana, F. Wypych, Mater Res., **2009**, 12, 1.
- [2] I Y. Jeon, J. B. Baek, J. Mater., **2010**, 3, 3654.
- [3] Y. Zhou, J. He, Jun Hu, B. Dang, J. Appl. Polym. Sci. **2016**, 133, 42863.
- [4] J. Jordan, K. I Jacob, R. Tannenbaum, M. A. Sharaf, I. Jasiuk, Mater. Sci. Eng. **2005**, 393, 1.
- [5] M. Berta, C. Lindsay, G. Pans, G. Camino, Polym. Degrad. Stabil. **2006**, 9, 1.