

SYNTHESIS OF PLA-PEG COPOLYMER AND ITS CHAIN EXTENDING WITH DI-ISOCYANATES. STRUCTURE, DEGRADATION AND POTENTIAL UTILIZATION.

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Introduction

Lactic acid (LA) polymer (PLA) and copolymers are recognized for their biocompatibility and biodegradability and have wide used in many fields.

In this work, poly(lactic acid)/poly(ethylene glycol) (PLA/PEG) copolymer predominantly terminated with OH groups was prepared and subsequently reacted with di-isocyanates to produce poly(ester-urethane) (PEU). The properties of the products and their potential utilization as nano fibers and nano/micro capsules were investigated.

Materials and Methods

PLA/PEG – LA was dehydrated 4 h at 160 °C, p = 20 kPa. Then, 0.4 % of Sn(Oct)₂ +7.5 % PEG (4000) was added. Reaction continued 24 h, 0.1 kPa.

PEU – 30g of PLA/PEG was melted (N₂, 160 °C). Then, MDI (CAS 101-68-8) or HMDI (822-06-0) was added and reaction continued for 30 min.

Electro spinning – 12% DMF solution on PP nonwoven substrate.

Nano particles – Formed by solvent evaporation method according to [1].

Results and discussion

In Fig. 1 (upper part) the weight average molecular weight of products are shown. It can be seen, that after addition of di-isocyanate the M_w increased significantly. This was more dominant in case of HMDI, where the highest M_w ~ 225 000 kg/mol was achieved. This showed on successful reaction between chain end groups and di-isocyanate compounds. In the lower part of Fig. 1 the degradation behavior in buffered solution (pH=7.4, 37 °C) is presented. It can be seen, that the type and concentration of di-isocyanate compound play a significant role during hydrolysis. Enhanced hydrolysis was observed in case of HMDI at the lowest concentration, while MDI

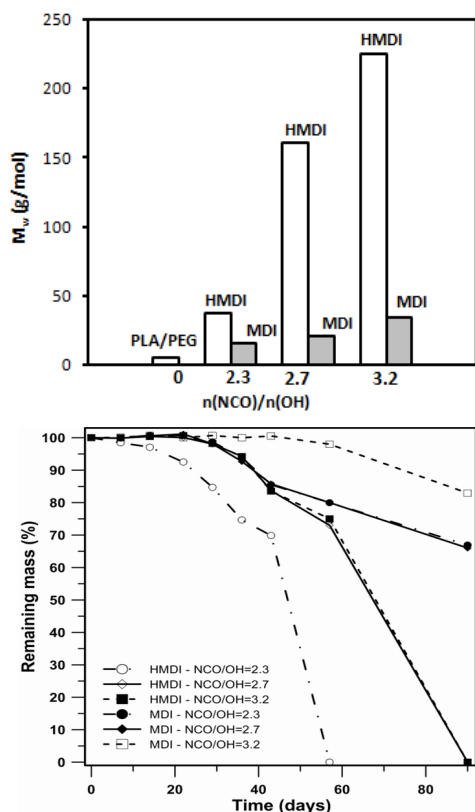


Figure 1 – The M_w (up) and degradation profiles (lower) of PEU products.

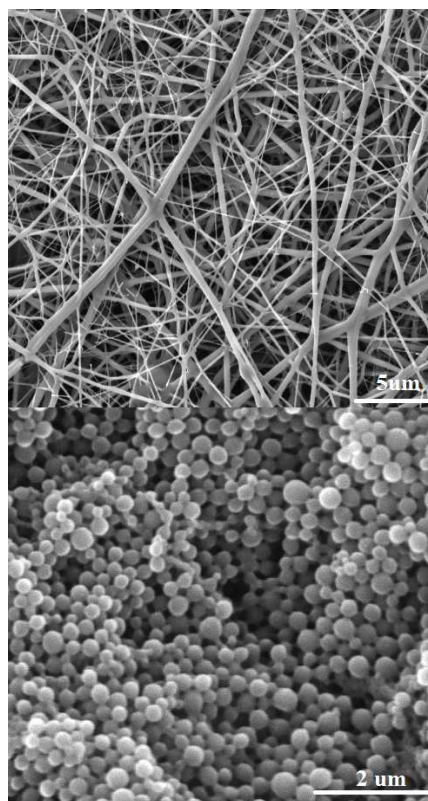


Figure 2 – SEM images of nano fibers (up) and particles (down).

provided more stable products (compact even after 90 days). Fig. 2 depicts nano fibers and particles successfully formed from prepared PEU. It can be seen, that in case of fibers (10 layers) the combination of nano and micro structures was achieved, which can be beneficial for example in filtration technology. In case of microparticles, the average diameter was found to be about 200 nm (light scattering, not presented) and they can be utilized in the area of encapsulation.

Conclusions

Poly(ester urethane) based on PLA/PEG copolymer was prepared. It can be successfully utilized in nano/micro fabrication like, fibers and particles.

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References

1. Stloukal P., Kucharczyk P., Sedlarik V. *et al.*, J. Agric. Food Chem. 60: 4111–4119, 2012.