Experimental and numerical Simulation properties of melt compounded polyamide graphene films

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Due to the outstanding properties of graphene compared to conventional materials, the interest in graphene based composites has grown in recent years in research and industry. Despite the many investigations and research results on the material itself, serial production of graphene based products has not yet been possible.

In the present study, a possibility is presented to use the advantages of graphene also on an industrial scale. The aim of the project was to develop a smooth film with reduced gas-permeability while improving mechanical properties. The matrix material used was a semi-aromatic polyamide with a high permeability for helium. By compounding different percentage of commercial graphene nanoparticles with support of dispersants on a twin-screw extruder followed by sheet dye and calender films were prepared (Fig. 1). According to the Nielsen [1] model the diffusion path extended and decreased the permeability to one-fifth of the initial value.

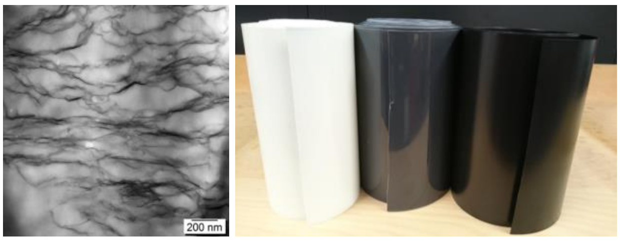

Fig. 1: left: orientated graphene nanoparticles; right: calender films with different filler content

Furthermore, to analyze the mechanical material behavior, experimental investigations in the form of tensile and relaxation tests were carried out and the results of these experiments were used for numerical simulation [2].
Being based on industrial relevant techniques only, the here presented results are of high interest for the serial production of many graphene and graphene related products [3].

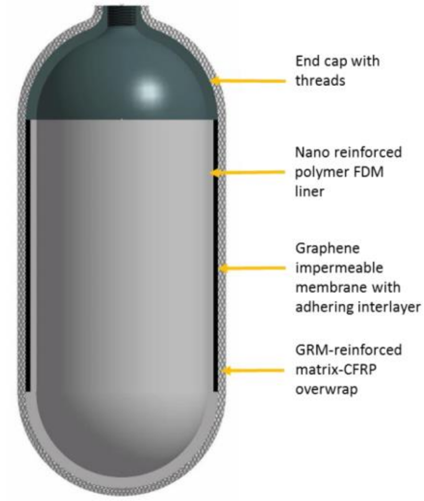

Fig. 2: Hydrogen storage tank with graphene based film

In combination with new 3D printing and sophisticated joining technologies such graphene reinforced films offer the possibility to fabricate high strength, low-weight and low-permeability hydrogen storage tanks, as schematically shown in Figure 2.

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References

[1] Nielsen, L. E. J. Macromol. Sci., Chem. (1967), A1, 929.
[2] P. Haupt, Springer, Continuum Mechanics and Theory of Materials (2002).
[3] A. Zurutuza, C. Marinelli, Nature Nanotechnology, Challenges and opportunities in graphene commercialization (2014), 730-734.