Synthesis of highly amorphous polyvinyl alcohol/reduced graphene oxide nanocomposite with promising electrical percolation threshold

R. Adami[1]*, P. Lamberti[2,3], M. Casa[4], N. D'Avanzo[2], M. Sarno[1,3], D. Bychanok[6], P. Kuzhir[7], C. Yu[8], H. Xia[8], P. Ciambelli[4]

[1]*Department of Physics, University of Salerno.*
[2]*Department of Information and Electrical Engineering and Applied Mathematics, University of Salerno.*
[3]*Centre NANO_MATES, University of Salerno.*
[4]*Narrando srl, Via Giovanni Paolo II, 132, 84084 Fisciano (SA), Italy*
[6]*Research Institute for Nuclear Problems Belarusian State University (Belarus)*
[7]*Dept. of Physics and Mathematics, University of Eastern Finland (Finland)*
[8]*State Key Lab of Polymer Material Engineering, Sichuan University, Chengdu, 610065, Sichuan, P.R. China*
**radami@unisa.it*

1. Introduction

The novel high amorphous polyvinyl alcohol (HAVOH) is water soluble, biodegradable polymer and has good compatibility with most inorganic/organic fillers. It has excellent extrusion processability, ease of use in coating, and oxygen barrier properties and has been patented and commercialized with the trade name G-Polymer. It has been studied in a blend with chemically-modified organoclays [1] and as modified matrix loaded with multiwalled nanotubes [2]. HAVOH/rGO composites can be considered commercially competitive compared to benchmarks in several fields, as electrically conductive composite materials, electromagnetic shielding and additive manufacturing, therefore it is interesting to study G-Polymer/reduced graphene oxide (rGO) nanocomposite obtained by solution blending process of HAVOH and Graphene Oxide (GO) water solutions and a subsequent 'in situ' reduction of GO.

2. Results and discussions

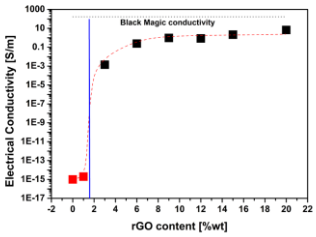

Fig. 1. Percolation curve for HAVOH/rGO nanocomposite

The HAVOH/rGO nanocomposite was prepared by mixing of two water solutions, containing GO and G-Polymer respectively, in order to obtain 20%wt of GO. The solid composites, then, underwent thermal treatment for 'in situ' GO reduction for different times [3]. After the optimization of the reduction time, HAVOH/rGO composites with different concentrations in order to evaluate the electrical conductivity of the materials. The materials obtained were mechanically grinded and hot pressed, then bone-like samples were modeled in order to evaluate mechanical properties of the nanocomposites. The obtained nanocomposite presents low percolation threshold (~ 1.7 %) and high electrical conductivity (~ 1 S/m, Fig. 1) due to the uniform dispersion in the polymer matrix as a result of the solution blending process and the good reduction level of GO. Already at 9 wt% of rGO the conductivity of the nanocomposite is 1 S/m, 3 order of magnitude higher than the reference value of PVA/rGO system [4] and not far from the conductivity of Black Magic filament, that is a traded system composed by poly lactic acid, graphene and nanotubes. For higher percentages a random value of conductivity is showed, probably for the degradation of samples.

3. Conclusions

In consideration of the processability of G-Polymer, the conductivity obtained by using rGO as filler and the low percolation threshold, the nanocomposite produced is a good candidate for 3D-printing of conductive structure, that can be used for packaging and electromagnetic shielding.

4. Acknowledgement

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5. References

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