Ternary composite of polypyrrole, montmorillonite clay and silver as conducting reinforcing agent for NBR rubber

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Keywords: *NBR, polypyrrole, surfact systems, Montmorillonite, silver nanoparticle.*

Introdution

Nowadays, the development of new technologies and materials has grown quickly. Among these materials, the mixtures of conductive polymers and elastomers have attracted much attention due to their electrical and mechanical properties. Electromagnetic radiation shielding, static charge dissipation and pressure sensors are examples of their applications[1]. Thus, this study aimed to prepare and to characterize conductive elastomers based on polypyrrole (PPy), silver nanoparticles (Ag), Montmorillonite clay (OMt) and nitrile rubber (NBR).

Experimental

Firstly, the Montmorillonite clay (MMT-Na^{+}) was organophilizated with a cationic surfactant, cetyltrimethylammonium bromide (CTAB). Then, this organomodified clay abbreviated as OMt was dispersed in Milli-Q water (2h), followed by the addition of the anionic surfactant sodium dodecyl sulfate (SDS). After stirring, pyrrole and silver nitrate (polymerization reaction initiator) were added to the suspension and reacted for 24 h. PPy pure was obtained using ammonium persulfate (PSA) as the reaction initiator with the same procedure. The composites were mechanically mixed with NBR into a Haake Rheometer at 150°C and 70 rpm for 6 minutes in the proportions 1, 5, 10 and 15% (w/w of composite/rubber). After that, the materials were vulcanized on sulfur-based process (zinc oxide, stearic acid, MBT (2-Mercaptobenzothiazole) and sulfur) at ratios in phr (parts per hundred parts of rubber) of 3; 1.5; 2 and 1, respectively, at 100°C and 50 rpm. The materials were characterized by FTIR, strain-stress mechanical tests, DSC and swelling measurements.

Results e Discussion

In the FTIR (not shown) spectra of the composites it is possible to observe the main bands of PPy, such as C=C stretching, C=N stretching, C–N stretching and C–H stretching. DSC curves before the vulcanization process, Fig.1a, show two main events. The first one concerned the T_g of NBR (around -33°C) and the second one (exothermic peak at 365°C) assigned to the cure reaction of the material. No differences of these two events were exhibit by the composites indicating no interaction between the materials.

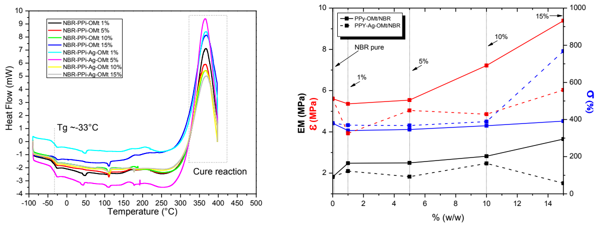

Fig. 1. DSC curves (a) and stress-strain results (b)

The mechanical properties, Fig 1b, showed an increased when the composite was added into the rubber. As the proportion of composite increases, greater are the values of deformation (σ) and stress at break (ε). Also, elastic modulus (E) increases values except for 15% (w/w) of composite with clay and silver nanoparticles on rubber, when there is a decreasing. Composites with clay act better as reinforcement than composites in presence of clay and silver nanoparticles. Furthermore, it was observed (Table 1) that the crosslinking process was effective due the gel fraction values obtained (89-98%).

Table1. Gel Fration of the composites

Pure NBR	NBR/PPy-OMt (%w/w)				NBR/PPy-Ag-OMt (%w/w)			
	1	5	10	15	1	5	10	15
97	98	98	97	96	98	97	95	90

Conclusion

The mechanical properties showed that PPy acts as reinforcement, mainly the composite with clay (PPy-OMT) and from FTIR and DSC results no interaction between the components were observed.

Acknowledgements

The authors gratefully acknowledge the financial support received from FAPESP (2007/50742-2, 2011/23742-7) and INEO.

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