Title: Mechanical Strengthening of PET by nitration

Abstract: Nitrated-PET

Polyethylene terephthalate (PET) is an engineering thermoplastic of wide scale industrial importance with commercial applications in synthetic fiber for fabric production, food packaging, and dielectric insulator film. PET and many variants of PET have been studied for potential molecular and bulk property enhancement to improve and expand use. In this paper, the impact of nitro addition to the polymer backbone on the thermal and mechanical performance is discussed. Previous work has shown that nitration of the aryl groups of PET causes a depression of the melting temperature with less impact on the glass transition temperature. The addition of the nitro group frustrates crystrallization requiring lower temperatures to drive formation. In this work, nitro addition is shown to impart increased stiffness and strength evidenced by an increase in modulus and yield strength. The mechanical enhancement is shown to pass through a maximum demonstrating an optimum nitro doping level for improved mechanical performance. The enhancement is attributed to an increase in intersegment attractions enabled by the ability of the nitro group to polarize the aryl pi-orbital electrons causing an increase in intersegment dipole-dipole interactions. At higher nitro concentration, the presence of the nitro group is believed to increase the segment free volume which offsets the increased segment attractions leading to a softening and weakening of the polymer. The impact is of higher consequence in the glass where segment motion is retarded due to insufficient thermal energy. The behavior is similar to that seen in other polymers chemically doped with polarizing moieties and resembles the characteristics of internal antiplasticization.

SAND Number: 2013-8300 C

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