Toughening with Little Stiffness Loss: Polyamide Filled with ABC Triblock Copolymers

Laurent Corté,*,†,§ Valéry Rebizant,⊥,† Gilles Hochstetter,‡ François Tournilhac,† and Ludwik Leibler†

Matière Molle et Chimie, Ecole Supérieure de Physique Chimie Industrielles (UMR ESPCI-CNRS 7167), 10 rue Vauquelin 75231 Paris Cedex 05, France, and CERDATO, Arkema, 27470 Serquigny, France

Received May 15, 2006; Revised Manuscript Received September 28, 2006

ABSTRACT: In semicrystalline polymers, important toughening is obtained with dispersions of rubber particles. However, adding rubber most often induces a substantial loss in elastic modulus. In the present study, we investigate how to avoid such softening by using ABC triblock copolymers with low rubber content. A polyamide-12 matrix is toughened with polystyrene-*block*-polybutadiene-*block*-poly(methyl methacrylate) (SBM) triblock copolymers containing less than 40 wt % of rubber. We compare the mechanical properties of such systems to those of polyamide-12 toughened with pure reactive rubber. Impact properties are characterized by instrumented Charpy testing and post-mortem observations of crack surfaces. We report that dispersions of 10−20 wt % of SBM improve remarkably the impact strength, even at low temperature, without altering the elastic modulus of the polyamide matrix. Microscopic observations suggest that the large differences in impact strength between pure rubber and SBM-filled polyamide arise from differences in particle size and cavitation stress. Three-point bending measurements and dynamic mechanical analysis show that the high modulus of polyamide toughened with SBM is directly related to the low rubber content of the SBM copolymer and that softening also seems to be attenuated by the presence of hard glassy domains of S and M acting as stiffening agents.