The damping characteristics of polymeric nanocomposites reinforced with carbon nanotubes is studied using micromechanical modeling and experiments. Two damage dissipation mechanisms namely interfacial and viscoelastic damping contribute to the damping properties of the polymeric nanocomposites. Incorporation of stiff fillers in the structure of the polymeric materials leads to a reduction of viscoelastic damping in the composites. However, inclusion of the nanotubes in the polymeric matrix also introduces a new dissipation mechanism along the interface with the polymeric phase. In order to study the dynamic behavior of the nanocomposites, normal and shear stress distributions along the nanotubes as the function of their orientation to the loading were achieved based on a shear-lag Cox model. Consequently, the slippage of the nanotube surrounded by polymeric phase as function of external loading and orientation of fibers was determined. Contribution of the viscoelastic damping to the nanocomposite behavior as the function of nanotube orientation and content was also studied. The total damping property of the nanocomposites represent the combined action of the two involved mechanisms. Nanocomposite specimens containing 0.5, 1.0, 3.0, 5.0, and 6.0 wt. % of the nanotubes were prepared. The damping and energy dissipation in the produced specimens were studied using dynamic mechanical experiments. Experimental results showed good agreement with the results abstained from the modeling.