Physicochemical and Thermal Studies of Viscose Rayon Borate Fiber and Its Carbon Fiber

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ABSTRACT: Nonhalogen compounds have been studied for improvements in the flameproofing property and toxicity of flame retardants. Borate compounds have properties of multifunctional smoke suppressants, flame retardants, and afterglow suppressants. In this study, borate was coupled onto the surface of viscose rayon felt. Coupling and carbonization were confirmed by attenuated total reflectance Fourier transform infrared (ATR FTIR). The initial carbonization temperature was certified with ATR FTIR, elemental analysis of carbon, and thermogravimetric analysis. In the carbonization step, all chemical groups of the surface of the viscose rayon felt degraded to the various gases. Moreover, the weight percentage of the carbon element increased with increasing carbonization temperature. Initial rapid thermal degradation temperatures of viscose rayon prepared at various temperatures increased with the increasing reaction temperature. The activation energy was calculated with the Freeman and Carroll method. The activation energy of borate-coupled viscose rayon decreased much more than before coupling. However, the activation energy increased with the increasing carbonization temperature in the carbonization step. Viscose rayon borates showed higher limiting oxygen index (LOI) values and volumetric resistance rate values than viscose rayon phosphates. In this article, the relationship between the activation energy and LOI is studied. The synthesized viscose rayon borate is found to be highly effective as a flame retardant and electrically resistant. © 2001 John Wiley & Sons, Inc. J Polym Sci Part A: Polym Chem 39: 3875–3883, 2001

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INTRODUCTION

In recent years, the development of halogen-free fire-retardant polymers that do not produce any corrosive and toxic hydrogen–halide gases during combustion has been a subject of considerable interest even though halogen-containing polymers show a high flameproofing effect.[1–4] As such, phosphate compounds have been highlighted as nontoxic, inexpensive, and good flame-retardant materials.[5,6] However, these compounds have a problem of low insulation due to their high electric conductivity.[7–9] This means that phosphate compounds cannot be used as the cover material for a high-voltage electric wire. Accordingly, we aimed with this study to develop a dual-functional material with both low electric conductivity and high flame retardancy.

Borate is well known as a unique multifunctional fire retardant. It can function as a flame

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