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CHARACTERIZATION OF STRUCTURAL CHANGES IN NONWOVEN FABRICS DURING LOAD-DEFORMATION EXPERIMENTS

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ABSTRACT

Current efforts to establish links between processing conditions and the structure and properties of nonwoven fabrics in general, and for point-bonded (spot-bonded) nonwovens in particular, would be served significantly by an in situ experimental visualization and measurement of the structural changes which occur during controlled-deformation experiments. In this study, structural parameters such as fiber orientation distribution function, bond-region strain, unit cell strain, and shear deformation of the unit cell during controlled-deformation experiments are explored to provide quantitative measures and so determine the role of bonding temperature on deformation behavior.

1. INTRODUCTION

The high rate of growth in nonwovens has led to a substantial increase in research aimed at establishing links between structure (Kim, In press; Lee, 1983) and desired macroscopic properties of these materials (Pourdeyhimi, 1994; Pourdeyhimi, 1996; Pourdeyhimi, 1997, Pourdeyhimi, 1999). However, few attempts have been carried out at the macro scale without a sufficient insight into the mechanisms responsible for the deformation characteristics of these fabrics (Thorr, 1998).

We recently reported on a new device designed for *in situ* monitoring of the changes in the structure of a nonwoven fabric during its deformation (Kim, In press). In this study, these structural and deformation parameters such as fiber orientation distribution function, bond-region strain, unit cell strain, shear deformation of the unit cell, etc., under tensile deformation of the nonwoven fabric are explored for a series of point-bonded nonwoven fabrics produced at different bonding temperatures.

2. MATERIAL AND METHODS

The nonwoven fabric was made from staple, carded polypropylene webs. The temperature of calendar rolls for bonding the fibers was varied from 140 ^{o}C to 180 ^{o}C in increments of 10 ^{o}C at a constant calendar roll pressure of 40 psi. The nonwovens produced had a final weight of 24 g/m^2.

Image Acquisition and Tensile Testing

The components of the concurrent tensile testing and image acquisition instrument are shown in Figure 1. The tensile unit has been designed such that, for each strain increment, the jaws move by an equal distance in opposite directions.